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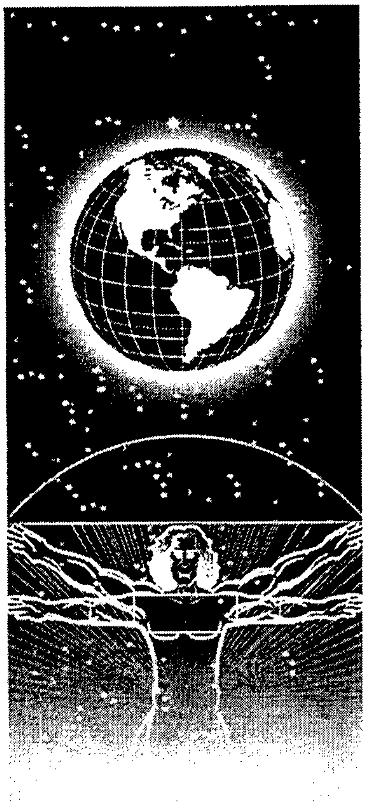

UNITED STATES AIR FORCE RESEARCH LABORATORY

A Comparison of Male and Female Acceleration Responses During Laboratory Frontal -Gx Axis Impact Tests

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TECHNICAL REVIEW AND APPROVAL

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This report has been reviewed by the Office of Public Affairs (PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

FOR THE DIRECTOR

F. Wesley

F. Wesley Baumgardner
Acting Chief, Biodynamics and Protection Division
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13. ABSTRACT (Maximum 200 words)
The incorporation of women into combat aircraft is expected to result in greater numbers of cockpit ejections with female crewmembers. Current safe ejection criteria are based on injury models which were established and validated using predominantly male data, and therefore do not fully take into account differences in biodynamic response due to size and gender. Recently the Air Force Research Laboratory (AFRL) has been addressing this deficiency by conducting experiments to evaluate gender differences using a population of female test subjects. In this study, male and female subjects were exposed to frontal impact acceleration pulses using a horizontal impulse acceleration facility. Acceleration responses were measured on the upper back at a point approximately in line with the first thoracic vertebral body. Analytical techniques were developed and used to compute the undamped natural frequency and damping coefficient ratio of these responses for each subject assuming a linear second-order approximation of the transfer of acceleration to the measurement point. No significant differences were found between males and females in either of these two parameters, nor was there any significant difference in the mean peak magnitude or mean time-to-peak of the measured acceleration response.

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PREFACE

The impact tests and data analysis described in this report were accomplished by the Biodynamics and Acceleration Branch, Biodynamics and Protection Division of the Air Force Research Laboratory (AFRL/HEPA) at Wright-Patterson Air Force Base, Ohio. The test program was funded under Workunit 71843101. Approval for the use of human volunteers in this program was authorized by the Wright Research Site Institutional Review Board (IRB) at Wright-Patterson AFB, Ohio under Protocol 95-11. Test facility and engineering support were provided by Dyncorp Inc. under contract F33601-96-DJ001.

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INTRODUCTION

As the number of women pilots operating combat fighter aircraft increases, the likelihood that women will be involved in emergency ejections increases. The risk of injury for female ejectees may be different than males due to their lower vertebral breaking thresholds [1,2] and differences in spinal loading due to smaller vertebral size [3]. Females have also been shown to be at greater risk in automobile frontal impacts [4,5]. Physiological differences between males and females such as height, weight, and mass distribution could also cause differences in biodynamic response during impact acceleration, which could alter the susceptibility to injury during an aircraft ejection. If it can be determined that there are no substantial gender differences in the biodynamic response to impact, then the evaluation of ejection spinal injury risk for females would be based primarily on the differences in vertebral strength and loading. Existing criteria used to quantify the biodynamic response parameters for frontal –x axis impact accelerations have been based on experiments where the subjects were predominantly males. Recently the Air Force Research Laboratory (AFRL) has been addressing this deficiency by conducting experiments to evaluate gender differences using a larger population of female test subjects. The biodynamic thoracic response of the seated subject restrained by lap belt and shoulder harness to an impact acceleration in the -x axis, has been described in terms of the displacement of the mass of a simple lumped-parameter, mass-spring-damper mechanical system [6,7,8]. The model can be represented by a second-order differential equation which can be used to calculate the magnitude of the response, with the maximum value corresponding to a given likelihood of injury for an acceleration impact pulse. In order to perform the model calculations, one needs to specify both the effective undamped natural frequency (ω_n) and damping coefficient ratio (ς) of the human/restraint system. Estimates of these two parameters for the -x axis model were developed by researchers at AFRL through analysis of data obtained during impact and vibration tests with human volunteers [6,7,9]. These results were based primarily on data from the male population and therefore need to be redefined for the female population.

The current study measures the biodynamic responses of both male and female subjects who were exposed to -x axis accelerations under identical conditions. The responses were measured using a linear tri-axial accelerometer package which was mounted externally on the subject's upper back during the exposures. Measurement of acceleration in the thoracic region during impact has also been documented by Ewing [10], who affixed accelerometers to a partial spinal pressure mold secured in place by a harness and positioned over the spinous process of the first thoracic vertebra. In the present study, the accelerometer was positioned below the spinous process of the seventh cervical vertebrae and approximately in-line with the first thoracic vertebral body (see Methods). The sampled response data were used in conjunction with analytical software to compute the undamped natural frequency and damping coefficient ratio. Peak magnitude and time-to-peak of the acceleration responses were also recorded and analyzed.

METHODS

Fourteen male and twelve female subjects were exposed to acceleration pulses at presumed sub-injury levels in the frontal -x axis using the AFRL Horizontal Impulse Accelerator (HIA) shown

in Figure 1 [11]. The pulses were approximately sinusoidal with duration of 200 ms and rise-time of 100 ms. Each subject was tested at seat acceleration levels of 8 G ($\Delta V = 35$ kph) and 10 G ($\Delta V = 45$ kph). The mean subject weights and sitting heights are summarized in Table 1. The ranges of weights were 50-64 kg for females and 46-108 kg for males. The ranges of sitting heights were 81-90 cm for females and 82-98 cm for males. Mean percentile values taken from the 1988 U.S. Army anthropometric survey [12] are included for comparison. The subjects were volunteer members of the AFRL Impact Acceleration Test Panel and were medically qualified for impact acceleration stress experiments through completion of a medical screening process more stringent than the USAF Flying Class II evaluation. Prior to testing, the subjects were fully briefed regarding both the medical risks and the nature of the test program.

Figure 1. Female Subject Prior to Impact Test on Horizontal Impulse Accelerator

The subjects were positioned in a generic seat rigidly mounted to the HIA sled in an upright position, with the seat back perpendicular to the line of acceleration. Ballast was added to the sled to ensure the same total sled/subject weight for each test. The head rest of the seat was mounted perpendicular to the seat pan and parallel to the seat back, and was positioned in-line with the seat back. The subjects were restrained using a standard PCU-15 (large subjects) or PCU-16 (small subjects) combined restraint/parachute harness and HBU lap belt (Figure 1). The PCU harness consists of two shoulder straps with 4.5 cm wide webbing sewn into a lightweight jacket. The shoulder straps are joined together with a buckle at the chest and extended up over the shoulders and behind the seat back where they were affixed to load cells. The HBU lap belt consists of a single strap with a buckle in the middle and tension adjusters on both sides. It was anchored to load cells at either side of the seat pan near the junction of the seat back. Both the

shoulder straps and lap belt were pretensioned to 20 ± 5 lbs at each attachment point just prior to each test. The subjects' thighs and wrists were loosely restrained by additional single straps. Each subject wore cutoff long underwear and a standard HGU-55/P flight helmet.

An accelerometer was mounted to the underside of the seat to measure input acceleration. The subjects' acceleration responses were measured using a linear tri-axial accelerometer package which was mounted firmly on the upper back using special adhesive tape. It was positioned below the spinous process of the seventh cervical vertebrae and approximately in-line with the first thoracic vertebral body (this measurement will be referred to as T1). The resultant T1 acceleration in the -x axis was obtained by combining the x and z components of the accelerometer output using $x(\cos\theta) + z(\sin\theta)$, where θ was the mean angle of spinal curvature measured at 29 ± 5° with respect to the vertical plane for the current subject pool (no significant differences were found in θ between males and females). Head acceleration, chest acceleration, and seat force were also measured in all three axes. Data were collected at 10,000 samples per second by an on-board data acquisition system which provided digitization and anti-aliasing filtering at 2.5 KHz using two low-pass, 6-pole Butterworth filters in series. During initial processing, the data were digitally filtered for noise using a 60 Hz low-pass software filter (4-pole Butterworth) and decimated to 1,000 samples per second.

Table 1. Mean Subject Weight and Sitting Height with Percentile Values

	Males	Females
Weight (kg)	79.9 (60th)	57.0 (30th)
Sit Height (cm)	91.6 (50th)	86.6 (65th)

A second-order differential equation (1) was used to model the impact response of the subjects and their restraint system at T1 with respect to the -x axis acceleration of the seat. This equation is also the basis for the Dynamic Response (DR) as defined by equation (2), which is used by the Air Force to estimate the probability of spinal injury during aircraft ejections [6,7,8].

$$-\frac{d^2x}{dt^2} = \frac{d^2\delta}{dt^2} + 2\zeta\omega_n\frac{d\delta}{dt} + \omega_n^2\delta \qquad (1)$$

where:

δ = deflection of the mass with respect to the model base

ζ = damping coefficient ratio

ω_n = undamped natural frequency

$\frac{d^2x}{dt^2}$ = acceleration input as a function of time

$\frac{d^2\delta}{dt^2}$ = relative acceleration of the mass with respect to the model base

$$\frac{d^2x}{dt^2} + \frac{d^2\delta}{dt^2} = \text{acceleration response of the mass}$$

$$-\frac{\omega_n{}^2\delta}{g} = \text{Dynamic Response (DR)} \tag{2}$$

Equation 1 was used to determine the values of ω_n and ζ using the following approach: First, the measured input seat acceleration $\frac{d^2x}{dt^2}$ and a selected range of values for ω_n (1-20 Hz) and ζ (0-1), were used to solve the equation for δ, $\frac{d\delta}{dt}$, and $\frac{d^2\delta}{dt^2}$ at each sampled data point using computer integration techniques. T1 acceleration response curves were then generated by computing $\frac{d^2x}{dt^2} + \frac{d^2\delta}{dt^2}$ for each combination of ω_n and ζ. Each computed T1 acceleration curve was then compared to the actual measured T1 acceleration curve by performing a weighted least squares fit of the two data sets using their respective values of rise-time, peak g level, start time, and end time. The peak value of the rise-time was obtained by taking a fraction (0.5 to 0.8 depending on the curve shape) of the measured peak acceleration, and recording the time at which this value occurred for both the rising and falling slopes of the curve. The average value of these times was considered the peak of the rise-time, and the rise-time itself was then defined as the difference between this calculated peak time and the start time. The start time and end time were defined as the times recorded at 0.2 G on the rising and falling slopes of the curve. The computed data set with the best least squares fit was used to provide the final values of ω_n and ζ. These values were recorded for each subject, and the fit of the acceleration responses was confirmed by plotting the two sets of data as shown in the sample plot in Figure 2.

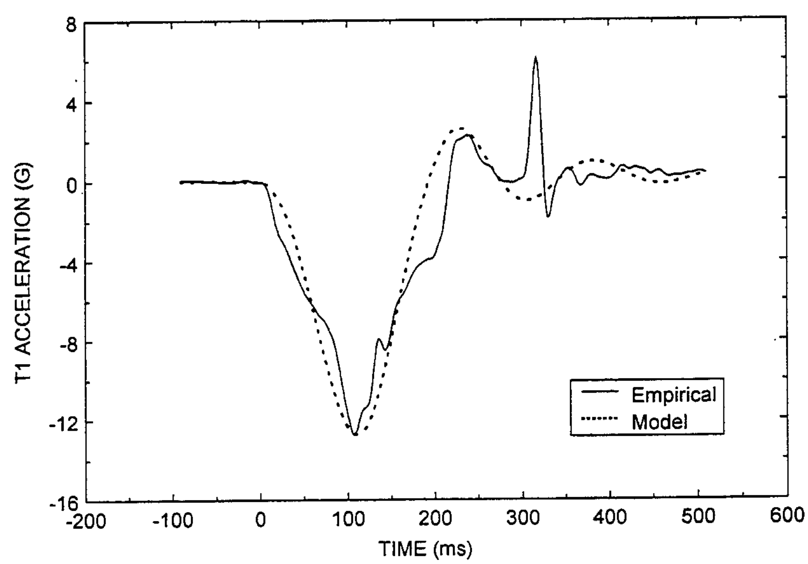

Figure 2. Model and Empirical T1 Acceleration Response

The mean error in rise-time and peak g between the two data sets was then computed for each set of plots. Means and standard deviations, scatter plots, Mann-Whitney U tests, and Pearson Product-Moment Correlations were performed using statistical software.

RESULTS

The mean peak seat acceleration input is shown in Table 2 for both males and females. The peak magnitude and time-to-peak of the input were almost identical between the two groups (< 4%) at nominal levels of 8 G and 10 G. Only the seat peak magnitude at 10 G showed a significant difference at $\alpha = 0.05$, but this difference was extremely small (1%).

The subjects' mean peak T1 acceleration response was nearly identical for both males and females as shown in Table 3. The peak magnitude of the response was 9.4 G for males and 10.1 G for females at 8 G seat input, and 12.7 G for males and 12.6 G for females at 10 G seat input. The mean time-to-peak response was 116 ms for males and 110 ms for females at 8 G, and 107 ms for males and 101 ms for females at 10 G. None of these differences was significant at $\alpha = 0.05$.

Table 2. Mean Peak Seat Acceleration and T1 Acceleration Response at Nominal 8 G Seat Input

	Males	Females	% Diff	Signif
Seat (G)	7.8 ± 0.2	7.9 ± 0.1	+1 %	NSD
Seat (ms)	95 ± 6	97 ± 7	+1 %	NSD
T1 (G)	9.4 ± 1.2	10.1 ± 1.1	+7 %	NSD
T1 (ms)	116 ± 12	110 ± 15	-5 %	NSD

Table 3. Mean Peak Seat Acceleration and T1 Acceleration Response at Nominal 10 G Seat Input

	Males	Females	% Diff	Signif
Seat (G)	9.7 ± 0.1	9.8 ± 0.1	+1 %	$\alpha = 0.05$
Seat (ms)	98 ± 5	103 ± 5	+4 %	NSD
T1 (G)	12.7 ± 1.8	12.6 ± 1.4	-1 %	NSD
T1 (ms)	107 ± 9	101 ± 18	-6 %	NSD

Peak magnitudes of the T1 acceleration response for individual subjects were plotted versus subject weight and are shown in Figure 3. Pearson Product-Moment Correlation tests demonstrated no significant correlations between the T1 peak magnitudes and subject weight for either males or females at 8 G or 10 G ($r < 0.50$, $\alpha = 0.05$). Nor were any significant

correlations found between the T1 peak magnitudes and subject sitting height ($r < 0.18$, $\alpha = 0.05$).

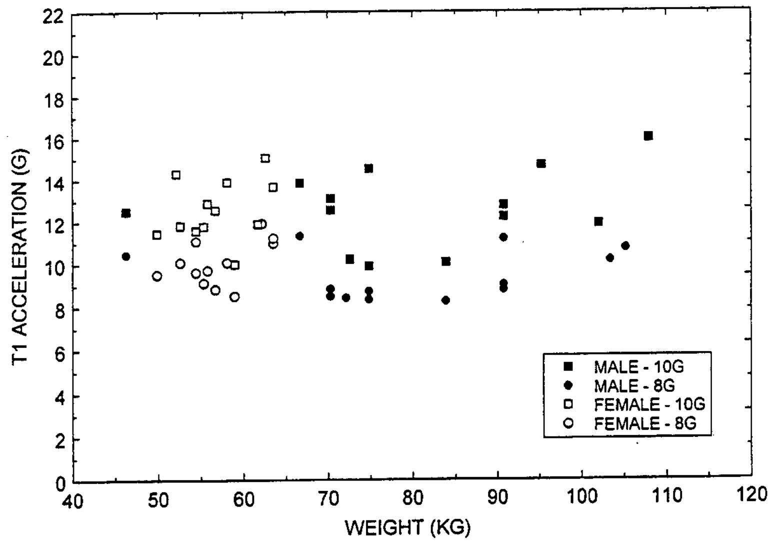

Figure 3. Scatterplot of T1 Acceleration Peak Magnitude Versus Weight for Male and Female Subjects at 8 G and 10 G Seat Acceleration Inputs.

The T1 time-to-peak responses for individual subjects were plotted versus subject weight and are shown in Figure 4. Weak correlations were present between the T1 time-to-peak and subject weight for males at both 8 G ($r = 0.54$) and 10 G ($r = 0.51$), while no correlations were found for

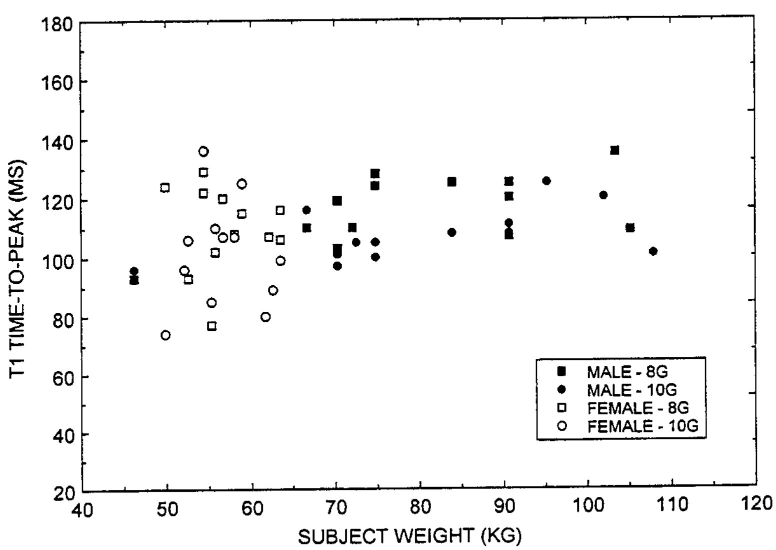

Figure 4. Scatterplot of T1 Time-to-Peak Acceleration Versus Weight for Male and Female Subjects at 8 G and 10 G Seat Acceleration Inputs

females ($r < 0.05$). None of the correlations was significant at $\alpha = 0.05$. Similarly, weak correlations were found between the T1 time-to-peak responses and subject sitting height for males at 8 G ($r = 0.52$) and 10 G ($r = 0.35$), while the correlations for females were again very small or nonexistent ($r < 0.30$). None of these correlations was significant at $\alpha = 0.05$.

The undamped natural frequency (ω_n) and damping coefficient ratio (ς) for each subject were calculated using the analytical techniques described in Methods, with the mean values for males and females shown in Tables 4 and 5. The average error of the model fit for both males and females was less than 2%. No significant differences were present in either the ω_n or the ς at seat input levels of 8 G compared to 10 G ($\alpha = 0.05$). For the *combined* 8 G and 10 G tests, the mean ω_n was 41.1 rad/sec for males versus 43.2 rad/sec for females, and the mean ς was 0.43 for the males versus 0.29 for the females. Neither of these differences was significant at $\alpha = 0.05$.

Table 4. Mean Undamped Natural Frequency (ω_n) for Males and Females at 8 G and 10 G Seat Acceleration Inputs

	Males	Females	% Diff	Signif
ω (8 G)	40.6 ± 5.1	44.6 ± 5.5	+ 10%	NSD
ω (10 G)	41.7 ± 3.8	41.7 ± 9.3	0%	NSD
ω_n (Total)	41.1 ± 4.4	43.2 ± 7.6	+ 5 %	NSD

Table 5. Mean Damping Coefficient Ratio (ς) for Males and Females at 8 G and 10 G Seat Acceleration Inputs

	Males	Females	% Diff	Signif
ς (8 G)	0.51 ± 0.33	0.30 ± 0.28	- 41%	NSD
ς (10 G)	0.36 ± 0.38	0.29 ± 0.27	- 19%	NSD
ς (Total)	0.43 ± 0.36	0.29 ± 0.27	- 33 %	NSD

The undamped natural frequency for individual subjects was plotted as a function of subject weight for 8 G and 10 G seat acceleration inputs, as shown in Figure 5. The correlations between the frequency and weight for combined 8 G and 10 G responses were $r = -0.37$ for males and $r = 0.09$ for females. With subject sitting height as the independent variable, the correlations were $r = -0.21$ for males and $r = -0.09$ for females. None of these correlations was significant at $\alpha = 0.05$.

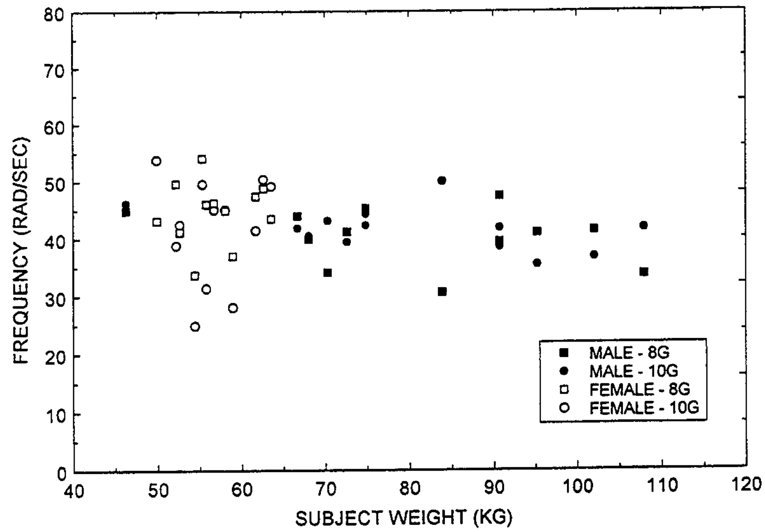

Figure 5. Scatterplot of Undamped Natural Frequency Versus Weight for Males and Females at 8 G and 10 G Seat Acceleration Inputs

The damping coefficient ratio for individual subjects was also plotted as a function of subject weight for combined 8 G and 10 G seat acceleration inputs, as shown in Figure 6. The

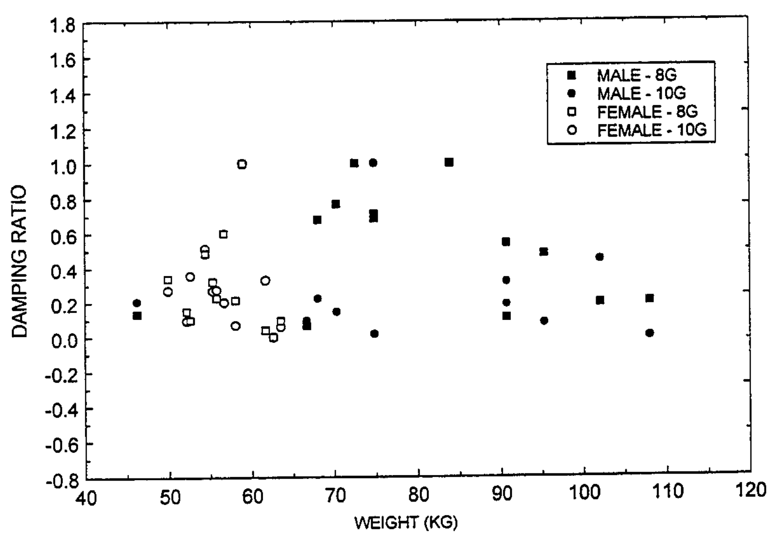

Figure 6. Scatterplot of Damping Coefficient Ratio Versus Weight for Males and Females at 8 G and 10 G Seat Acceleration Inputs

correlations between the damping coefficient ratio and weight were r = -0.11 for males and r = -0.14 for females. With subject sitting height as the independent variable, the correlations were r

= 0.03 for males and r = -0.06 for females. None of these correlations was significant at α = 0.05.

DISCUSSION

The use of a second-order differential equation to model the biodynamic response of seated subjects and their restraint system during impact accelerations has been well documented (see Introduction). In fact, the general shape of the T1 acceleration response curves was similar to results obtained in previous human dynamic response studies by Ewing [13,14], although the peak acceleration magnitudes in the current study were lower with less pronounced secondary positive peaks. The differences were probably due to differences in sled onset rate and initial head positioning, since the current study used a lower onset rate and maintained the initial head position farther back and in-line with the seat back.

The results of this study demonstrated similar measured peak acceleration responses at T1 for both males and females during 8 G and 10 G seat acceleration impacts in the –x axis. No statistically significant differences were found in the T1 acceleration peak magnitude between the two genders. Nor were any meaningful correlations found between the peak magnitude and the subjects' weight or sitting height. Although the time-to-peak acceleration was slightly less (< 6%) for females at both 8 G and 10 G seat accelerations, the differences were not statistically significant. Weak positive correlations were present between the time-to-peak acceleration and both subject weight and sitting height for males only. Differences in the subjects' mass or spring stiffness could have contributed to these correlations, as well as being responsible for the small gender differences in the time-to-peak response, since $\omega_n = \sqrt{\frac{K}{M}}$ [15] in a viscously damped oscillatory system.

The comparisons of male and female undamped natural frequency (ω_n) and damping coefficient ratio (ς) were based on the model calculations as described in the Methods section. The undamped natural frequency (ω_n) demonstrated a slightly higher (5%) mean value for females than males. Although the difference was not statistically significant, the slightly higher frequency was not unexpected since the females' mean time-to-peak acceleration (t) was slightly lower and $\omega_n = \frac{\Pi}{t\sqrt{1-\varsigma 2}}$ [16]. Differences in mass or spring stiffness between males and females could also have been a factor.

The damping coefficient ratio (ς) was found to be lower in females (33%) than in males. The lower damping coefficient ratio could also be due to gender differences in mass or spring stiffness since $\varsigma = \frac{C}{2M\sqrt{K/M}}$ [15]. However, the difference was not statistically significant due in part to the large individual differences among the subjects in both the male and female subject pools. A much larger sample size would therefore be required in order to more precisely quantify the gender differences in damping coefficient ratio.

Differences in height and weight did not appear to be a significant determinant in the biodynamic response to impact for either males or females. Therefore, although this study was based on response measurements from a subject pool with a range of weights and sitting heights falling

within the 30^{th} and 60^{th} percentiles of the military population, it is unlikely that the results would be substantially different for smaller females or larger males, since neither T1 peak acceleration, undamped natural frequency, nor damping coefficient ratio correlated well with either subject weight or sitting height. Only the time-to-peak acceleration response would be expected to increase slightly for larger males.

CONCLUSIONS

Male and female volunteer subjects demonstrated similar biodynamic responses during laboratory frontal –x axis impact tests. Although there were small gender differences in the time-to-peak response and the damping coefficient ratio, these differences could not be quantified without a substantially larger experimental sample size. In addition, large individual differences were present in all measured response parameters, particularly in the female subjects. These results indicate that there is not yet sufficient evidence to warrant the modification of response parameters for females when used in biodynamic injury models which are based on -x axis upper torso displacement during impact, even though these parameters were developed primarily with male subjects. However, further research is needed to ascertain if any differences exist between males and females in the injury thresholds which are associated with these biodynamic responses.

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APPENDIX A

TEST CONFIGURATION AND DATA ACQUISTION SYSTEM

TEST CONFIGURATION AND

DATA ACQUISITION SYSTEM FOR THE

INVESTIGATION OF THE EFFECTS OF GENDER

AND ANTHROPOMETRY ON DYNAMIC RESPONSE

DURING -Gx IMPACT ACCELERATION

(DRI STUDY)

TEST PROGRAM

Prepared under
Contract F33601-96-DJ001

November 1996

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and
Stephen E. Mosher

DynCorp
Enterprise Management
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INTRODUCTION

This report was prepared by DynCorp for the Armstrong Laboratory (AL/CFBE) under Air Force Contract F33601-96-DJ001.

The information provided herein describes the test system, seat fixture, restraint configuration, test subjects, test configuration, data acquisition, and the instrumentation procedures that were used in the Investigation of the Effects of Gender and Anthropometry on Dynamic Response During -Gx Impact Acceleration (DRI Study) Test Program conducted on the Horizontal Impulse Accelerator during September through December 1995.

1. TEST SYSTEM

The AL/CFBE Horizontal Impulse Accelerator System was used for all of the one hundred fifty-one tests. The Horizontal Impulse Accelerator System consists of the 24-inch HYGE actuator, the test sled and 240 feet of track. The Horizontal Impulse Accelerator is designed to simulate an impact profile by accelerating the test sled down the track.

The energy required to produce the impact acceleration is generated within the actuator cylinder (Figure A-1) by means of differential gas pressures acting upon a thrust piston. This thrust piston is attached to a thrust column assembly, which is used to impact the sled. As pressure moves the thrust assembly, the sled is accelerated from an initial stationary position to a predetermined peak acceleration level and is then allowed to decelerate by coasting or by brake application. Various acceleration profiles may be obtained by changing the differential pressures, the travel length of the thrust assembly and the metering structure on the thrust piston. The sled glides along the track rails on twelve glide pads. The sled braking system consists of caliper brakes, which grip the track rails when activated by onboard compressed nitrogen gas. The track rails are one inch thick and the total track length is 240 feet. Two metering pins, as indicated in Table A-1, were used to obtain the desired acceleration profiles.

CELL	NOMINAL PULSE AMPLITUDE (G)	METERING PIN
A	6.5	23
B	8.0	23
BB	8.0	11
C	10.0	23

TABLE A-1: TEST MATRIX

2. SEAT FIXTURE

The experimental seat fixture was the 40G seat mounted on the Horizontal Impulse Accelerator Sled and was oriented to provide a -Gx acceleration vector. The seat back angle was zero degrees (vertical) and the seat pan was horizontal. The headrest was mounted in line with the seat back. Figure A-2 illustrates the seat fixture.

The subjects were secured in the seat with a PCU-15/P or PCU-16/P restraint harness with two shoulder straps and an ACES II lap belt. The lap belts and shoulder straps were preloaded to 20 ±5 pounds, as required in the test plan.

Each foot of the subject was restrained by a strap that encircled the subject's foot and was attached to the foot pedal. Another strap encircled each of the subject's thighs. The subject's hands were placed under the thigh restraint. Figure A-2 also illustrates the subject's foot and hand restraints.

Ballast was used on the sled to keep the total weight of the sled and subject constant. The amount of ballast was equal to two-hundred twenty pounds minus the weight of the test subject.

3. TEST SUBJECTS

Both manikin and human test subjects were used during this test program. The manikins tested included:

A 95th percentile Alderson manikin, designated VIP-95.
A 95th percentile manikin, designated Hybrid III.

The subjects wore a HGU-55/P flight helmet.

4. INSTRUMENTATION

The electronic data collected during this test program is described in Sections 4.1 and 4.2. Section 4.1 discusses accelerometers while Section 4.2 discusses load transducers. Section 4.3 discusses the calibration procedures that were used.

The measurement instrumentation used in this test program is listed in Tables A-2a through A-2f. These tables designate the manufacturer, type, serial number, sensitivity and other pertinent data on each transducer used. Table A-3 lists the manufacturer's typical transducer specifications.

Accelerometers and load transducers were chosen to provide the optimum resolution over the expected test load range. Full scale data ranges were chosen to provide the expected full scale range plus 50% to assure the capture of peak signals. All transducer bridges were balanced for optimum output prior to the start of the program. The accelerometers were adjusted for the effect of gravity using computer processing software. The component of a 1 G vector in line with the force of gravity that lies along the accelerometer axis was added to each accelerometer.

The accelerometer and load transducer coordinate system is shown in Figure A-3. The seat coordinate system is right-handed with the z axis parallel to the seat back and positive upward. The x axis is perpendicular to the z axis and positive eyes forward from the subject.

The y axis is perpendicular to the x and z axes according to the right-hand rule. The origin of the seat coordinate system is designated as the seat reference point (SRP). The SRP is at the midpoint of the line segment formed by the intersection of the seat pan and seat back. All vector components (for accelerations, angular accelerations, forces, moments, etc.) were positive when the vector component (x, y and z) was in the direction of the positive axis.

The linear accelerometers were wired to provide a positive output voltage when the acceleration experienced by the accelerometer was applied in the +x, +y and +z directions, as shown in Figure A-3.

The angular Ry accelerometers were wired to provide a positive output voltage when the angular acceleration experienced by the angular accelerometer was applied in the +y direction according to the right hand rule, as shown in Figure A-3.

The load cells were wired to provide a positive output voltage when the force exerted by the load cell on the subject was applied in the +x, +y or +z direction, as shown in Figure A-3.

All transducers except the sled accelerometers, sled velocity tachometer, and the foot load cells were referenced to the seat coordinate system. The foot load cells were referenced to the foot pedal coordinate system, as shown in Figure A-3. The sled accelerometers and the sled velocity tachometer were referenced to the sled coordinate system, as shown in Figure A-4. The x axis is horizontal and positive down track from the Horizontal Impulse Accelerator. The z axis is vertical and positive upward. The y axis is perpendicular to the x and z axes according to the right-hand rule.

The sled linear accelerometers were wired to provide a positive output voltage when the acceleration experienced by the accelerometer is applied in the +x, +y or +z directions, as shown in Figure A-4.

The sled velocity tachometer was wired to provide a positive output voltage when the sled moves in the +x direction, as shown in Figure A-4.

The sled velocity was measured using Globe Industries tachometers Model 22A672-2. The rotor of the tachometer was attached to an aluminum wheel with a rubber "O" ring around its circumference to assure good rail contact. The wheel contacted the track rail and rotated as the sled moved, producing an output voltage proportional to the velocity.

4.1 Accelerometers

The following sections describe the accelerometer instrumentation, as required in the AL/CFBE test plan.

The external chest accelerometer package consisted of three Entran Model EGE-72B-200 linear accelerometers mounted to a 1/2 x 1/2 x 1/2 inch aluminum block for accelerations in the x, y and z directions. An Endevco Model 7302B angular (Ry) accelerometer was mounted on a bracket outside the triaxial chest block. The accelerometers were inserted into a steel protection shield to which a length of Velcro fastener strap was attached. The package was placed over the subject's sternum at the level of the xiphoid and was held there by fastening the Velcro strap around the subject's chest. Figures A-5 and A-6 illustrate the chest accelerometer package.

Sled accelerations were measured using one Endevco Model 2262A-200 linear accelerometer for acceleration in the x direction and two Entran model EGE-72B-200 for accelerations in the y and z directions. The three accelerometers were attached to a 1 x 1 x 3/4 inch acrylic block and were mounted on the underside center of the sled.

Seat accelerations were measured using one Entran Model EGE-72B-200 linear accelerometer for acceleration in the x direction and one Endevco Model 7264-200 linear accelerometer for acceleration in the y direction. The two linear accelerometers were attached to a 1 x 1 x 3/4 inch acrylic block and were mounted near the center of a bracket mounted under the seat pan.

Human head accelerations were measured using three Entran Model EGE-72B-200 linear accelerometers and one Endevco Model 7302B angular (Ry) accelerometer. The accelerometers were mounted to the external edge of a plastic dental bite block. Each subject had his own set of custom fitted dental inserts that were used to support the bite block in his mouth. An infrared LED target was attached directly on the front of the plastic dental bite block. Figure A-7 illustrates the human head accelerometer package.

T1 x, y and z accelerations were measured using three Entran Model EGAXT-100 linear accelerometers. The accelerometers were mounted on a small acrylic base and the accelerometer package was mounted on the human subject with double stick tape.

4.2 Load Transducers

The following sections describe the load transducer instrumentation, as required in the AL/CFBE test plan.

The load transducer locations and dimensions are shown in Figures A-8a and A-8b.

Shoulder/anchor forces were measured using four AAMRL/DYN 3D-SW triaxial load cells, each capable of measuring forces in the x, y and z directions. The parameters measured are indicated below:

Left shoulder belt x, y and z force
Right shoulder belt x, y and z force
Left lap belt x, y and z force
Right lap belt x, y and z force

The lap anchor force triaxial load cells were located on separate brackets mounted on the side of the seat frame parallel to the seat pan.

The shoulder strap force triaxial load cell was mounted on the seat frame between the seat back support plate and the headrest, as illustrated by Figure A-10.

Left, right and center seat pan forces were measured using three load cells and three load links. The three load cells included two Strainsert Model FL2.5U-2SGKT and one FL2.5U-2SPKT load cells. The three load links, as shown in Figure A-11, were fabricated by DynCorp using Micro Measurement Model EA-06-062TJ-350 strain gages. All six measurement devices were located under the seat pan support plate. The load links were used for measuring loads in the x and y directions, two in the x direction and one in the y direction. Each load link housed a swivel ball, which acted as a coupler between the seat pan and load

cell mounting plate. The Strainsert load cells were used for measuring loads in the z direction.

Left, right and center seat back forces were measured using three Strainsert Model FL2.5U-2SPKT load cells. Top, bottom and center seat back link forces were measured using three load links. The three load links, as shown in Figure A-11, were fabricated by DynCorp using Micro Measurement Model EA-06-062TJ-350 strain gages. All six measurement devices were located behind the seat back support plate. The load links were used for measuring loads in the y and z directions, two in the y direction and one in the z direction. Each load link housed a swivel ball, which acted as a coupler between the seat pan and load cell mounting plate. The Strainsert load cells were used for measuring loads in the x direction.

Head x, y and z forces were measured using one AAMRL/DYN 3D-SW triaxial load cell. The load cell was mounted on a rectangular mounting plate, which was attached to the upper seat back, as illustrated by Figure A-10. The headrest was attached directly to the load cell. The headrest was adjusted up or down depending on the location of the subject's head.

Left and right foot x, y and z forces were measured using two Michigan Scientific 4000 triaxial load cells. The load cells were mounted on the foot pedal adjustment bracket. The foot pedals were attached directly to the load cell, as illustrated by Figure A-12.

4.3 Calibration

Calibrations were performed before and after testing to confirm the accuracy and functional characteristics of the transducers. Pre-program and post-program calibrations are given in Tables A-4a through A-4d.

The calibration of all Strainsert load cells was performed by the Precision Measurement Equipment Laboratories (PMEL) at Wright-Patterson Air Force Base. PMEL calibrated these devices on a periodic basis and provided current sensitivity and linearity data.

The calibration of the accelerometers was performed by DynCorp using the comparison method (Ensor, 1970). A laboratory standard accelerometer, calibrated on a yearly basis by Endevco with standards traceable to the National Bureau of Standards, and a test accelerometer were mounted on a shaker table. The frequency response and phase shift of the test accelerometer were determined by driving the shaker table with a random noise generator and analyzing the outputs of the accelerometers with a Unisys 386/25 computer using Fourier analysis. The natural frequency and the damping factor of the test accelerometer were determined, recorded and compared to previous calibration data for that test accelerometer. Sensitivities were calculated at 40 G and 100 Hertz. The sensitivity of the test accelerometer was determined by comparing its output to the output of the standard accelerometer.

The angular accelerometers were calibrated by DynCorp by comparing their output to the output of a linear standard accelerometer. The angular accelerometer is mounted parallel to the axis of rotation of a Honeywell low inertia D. C. motor. The standard accelerometer is mounted perpendicular to the axis of rotation at a radius of one inch to measure the tangential acceleration. The D. C. motor motion is driven at a constant sinusoidal angular acceleration of 100 Hertz and the sensitivity is calculated by comparing the rms output voltages of the angular and linear accelerometers.

The shoulder/lap/head/foot triaxial load cells and load links were calibrated by DynCorp. These transducers were calibrated to a laboratory standard load cell in a special test fixture. The sensitivity and linearity of each test load cell were obtained by comparing the output of the test load cell to the output of the laboratory standard under identical loading conditions. The laboratory standard load cell, in turn, is calibrated by PMEL on a periodic basis.

The velocity wheel is calibrated periodically by DynCorp by rotating the wheel at approximately 2000, 4000 and 6000 revolutions per minute (RPM) and recording both the output voltage and the RPM.

5. DATA ACQUISITION

Data acquisition was controlled by a comparator on the Master Instrumentation Control Unit in the Instrumentation Station. The test was initiated when the comparator countdown clock reached zero. The comparator was set to start data collection at a preselected time.

A reference mark pulse was generated to mark the electronic data and Selspot optical motion data at a preselected time after test initiation to place the reference mark close to the impact point. The reference mark time was used as the start time for data processing of the electronic and Selspot optical motion data.

Prior to each test and prior to placing the subject in the seat, data were recorded to establish a zero reference for all data transducers. These data were stored separately from the test data and were used in the processing of data.

5.1 EME DAS-64 Data Acquisition and Storage System

The EME DAS-64 Data Acquisition System, manufactured by EME Corporation, was used for this test program. The EME DAS-64 Data Acquisition System is a ruggedized signal conditioning and recording system for transducers and events. The system is powered by an external 19 Volt DC power supply and communicates with the host Gateway 486 computer through an RS-422 interface. The DAS-64 contains 4 Mbyte of onboard memory, which can hold 129,000 test data samples per channel for 64 channels.

The EME DAS-64 is designed to withstand a 60 G 100 ms shock from a half sine shock profile in the three primary axes. The EME DAS-64 is also designed to withstand a 10-2000 Hz sine sweep with an amplitude of up to 60 G. Installation of the EME DAS-64 on the sled is shown in Figure A-13.

The EME DAS-64 will accommodate up to 64 transducer channels and 16 events. The signal conditioning front end excites, amplifies and offsets transducer input signals to appropriate levels for analog to digital conversion. Transducer signals are amplified, filtered, digitized and recorded in onboard solid state memory. A block diagram of the EME DAS-64 is shown in Figure A-14.

The high speed RS-422 board installed in the Gateway 486 computer communicated with the EME DAS-64 with a transfer rate of 1 Mbit/sec. The Gateway 486 computer configured the DAS-64 before the test and retrieved the test data from the onboard memory in the DAS-64 after the test was completed. The test data were later transferred to the DEC 3000-500 Alpha AXP through the thin wire Ethernet network and output to optical disk for permanent storage. The interrelationships among the

DAS-64 data acquisition, data analysis and data storage equipment are shown in Figure A-15.

The C program ADASEME on the Gateway 486 computer configured the DAS-64 prior to the start of the test, transferred test data from the EME DAS-64 when the test is completed, and stored the collected test data in a binary data file. The program is organized into 5 menu options. The menu options are: test setup, diagnostics, transducer calibration, test data conversion, view graphs, and test data collection. The program communicated with the EME DAS-64 Data Acquisition System by sending instruction over the RS-422 interface.

Test data could be reviewed after it was converted to digital format using the "quick look" SCAN_EME routine on the DEC 3000-500 Alpha AXP computer. SCAN_EME produced a plot of the data stored for each channel as a function of time. The routine determined the minimum and maximum values of each data plot. It also calculated the rise time, pulse duration, and carriage acceleration, and created a disk file containing significant test parameters.

5.2 Selspot Motion Analysis System

The Selspot Motion Analysis System utilizes photosensitive cameras to track the motion of infrared LED targets attached to different points on the test fixture. The three-dimensional motion of the LEDs was determined by combining the images from two different Selspot cameras. Two Selspot cameras were mounted onboard the sled. The side camera was a Selspot Model 411-2 (S/N 385) and the oblique camera was a Selspot Model 411-2 (S/N 384). Both cameras had 24 mm lenses. The Selspot cameras are shown in Figure A-16.

The Selspot System includes a ZCM 1450 video monitor and a Zenith Data Systems Z Select 100 microcomputer with 16 Mbyte RAM, HW VCU-2 VME Control Unit II, a camera interface module (MCIM), a 3.5" 1.44 Mbyte floppy disk drive, and a 404 Mbyte hard disk drive. The Selspot Computer System is shown in Figure A-17. The microcomputer uses the MS DOS 6.22 operating system. The Selspot data collection and processing are performed by the Selspot MULTILAB System software. The Selspot test data is transferred over the network to the optical disk drive on the DEC 3000-500 AXP Alpha computer for permanent storage.

The Selspot System was calibrated by determining the camera locations and orientations prior to the start of the test program. The camera locations and orientations were referenced to the coordinate system of the Position Reference Structure (PRS). The PRS is shaped as a tetrahedron with reference LEDs 1, 2, 3 and 4 located at the vertices.

Motion of the subjects' helmet top, helmet bottom, mouth, shoulder, chest and elbow were quantified by tracking the motion of six subject-mounted LEDs. Four reference LEDs were placed on the test fixture. Figures A-18 and A-19 identify the LED target locations.

The locations of the LEDs generally followed the guidelines provided in "Film Analysis Guides for Dynamic Studies of Test Subjects, Recommended Practice (SAE J138, March 1980)."

Photogrammetric data was collected from the six moving and four reference LEDs at a 500 Hz sample rate during the impact. Data collection started at T = -2 seconds for 5 seconds. The photogrammetric data was copied to an optical disk for permanent storage.

The data was processed starting at the reference mark time for 600 milliseconds on the Selspot Motion Analysis System, shown in the block diagram in Figure A-20. The camera image coordinates were corrected for camera vibration, converted into three-dimensional coordinates, and transformed into the seat coordinate seat.

A Kodak Ektapro 1000 video system was also used to provide onboard coverage of each test. This video recorder and display unit are capable of recording high-speed motion up to a rate of 1000 frames per second. The Kodak Ektapro 1000 Video System (less camera) is shown in Figure A-21. Immediate replay of the impact is possible in real time or in slow motion.

6. PROCESSING PROGRAMS

The executable image for the EME processing program is located in directory PROCESS of the DEC 3000-500 AXP Alpha computer and the test data is assumed to be stored in logical directory DATADIR. All plots and the test summary sheet are output to the LN03 laser printer. The test base file is output to directory PROCESS.

The Fortran program that processes the test data for the DRI Study (Horizontal Impulse Accelerator system) is named DRIHAC. The character string 'DRI' identifies the study and 'HAC' identifies the system (Horizontal Impulse Accelerator). Logical directory DATADIR is assumed to contain a test data file named '<test no>D.HAC' and a sensitivity file named '<test no>S.HAC'. DRIHAC assumes that the test data was collected using the EME data acquisition system.

DRIHAC requests the user to enter the total number of tests to be processed and the test number for each test. The default test parameters are retrieved from the test sensitivity file and displayed as a menu on the screen. The user may specify new values for any of the displayed test parameters. The test parameters include the subject ID, weight, age, height and sitting height. Additional parameters include the cell type, nominal G level, subject type (manikin or human) and belt preload status (computed or not computed). If the belt preloads were computed, then the shoulder and lap preloads are also displayed.

DRIHAC generates time histories for the sled x, y and z axis accelerations; the sled velocity; the seat x and y axis accelerations; the head x, y, z, Ry and resultant accelerations; the chest x, y, z, Ry and resultant accelerations; and the T1 x, y, z and resultant accelerations.

Time histories are also generated for the headrest x, y, z, resultant, tare corrected x and tare corrected resultant forces; the left shoulder x, y z and resultant forces; the right shoulder x, y, z and resultant forces; the left lap x, y, z and resultant forces; the right lap x, y, z and resultant forces; the left foot x, y, z and resultant forces; the right foot x, y, z and resultant forces; the left, right and center seat pan z axis forces, and their sum; the left and right seat pan x axis forces, and their sum; the seat pan y axis force; the seat pan resultant; the tare corrected seat pan x axis sum and seat pan resultant; the left, right and center seat back x forces, and their sum; the seat back z axis force; the top and bottom seat back y axis forces, and their sum; the seat back resultant; and the tare corrected seat back x axis sum and seat back resultant.

The user has the option to filter the test data using a four pole digital Butterworth filter. Values for the preimpact level and the extrema for each time history are stored in the test base file and printed out as a summary sheet for each test. The time histories are also plotted.

The output from DRIHAC is controlled by the parameter file 'DRIHAC.SET'. The parameter file can be used to enable or disable the generation of the data base summary file, the LN03 printer summary sheets, the LN03 plots, text files containing channel time histories, and digital filtering. The parameters file also allows the user to specify the analysis window time, the plot time increment, the digital filter cutoff frequency, and the average spine angle for males and females. This allows the user to rerun the analysis without regenerating unnecessary printer output and text files. The average spine angle is used to rotate the measured T1 accelerometer x and z axes into the seat coordinate system.

The parameter file 'DRIHAC.LST' is used to control the creation of the text files containing channel time histories. The time histories files are created with the filename '<Test Number>HAC.L<File Number>'. The file number starts at one and is incremented for each additional time history file that is created.

The parameter file 'DRIHAC.PLT' can be used to specify the individual plot pages that will be printed out. All of the plot pages are printed out if the file does not exist.

DYNCORP DIGITAL INSTRUMENTATION REQUIREMENTS

PROGRAM INVESTIGATION OF THE EFFECTS OF GENDER AND ANTHROPOMETRY ON DYNAMIC RESPONSE DURING -Gx IMPACT ACCELERATION (DRI STUDY)

DATES: 26-SEP-95 THRU 15-DEC-95

FACILITY HORIZONTAL IMPULSE ACCELERATOR

RUN NUMBERS: 5547 - 5697

DATA CHAN	DATA POINT	XDUCER MFG & TYPE	SERIAL NUMBER	XDUCER SENS	EXCITE VOLT / CHAN	FILTER SERIES / S/N	AMP GAIN / S/N	SAMPLE RATE / FORMAT	FULL SCALE SENS	FILTER HZ	XDUCER ZERO / RANGE	BRIDGE BALANCE RES	BRIDGE COMP RES	SPECIAL NOTATIONS
1	SLED X ACCEL	ENDEVCO 2262A-200	FR42	4.208 mv/G	10.00 / 1	- / -	29.7 / -	1K / -	20G	120	0V / +2.5 -2.5	-	-	
2	SLED Y ACCEL	ENTRAN EGE-72B-200	93C19-R07	2.448 mv/G	10.00 / 2	- / -	102.1 / -	1K / -	10G	120	0V / +2.5 -2.5	-	-	
3	SLED Z ACCEL	ENTRAN EGE-72B-200	93C19-R02	2.277 mv/G	10.00 / 3	- / -	109.8 / -	1K / -	10G	120	0V / +2.5 -2.5	-	-	
4	SEAT X ACCEL	ENTRAN EGE-72B-200	93C19-R14	2.290 mv/G	10.00 / 4	- / -	54.6 / -	1K / -	20G	120	0V / +2.5 -2.5	-	-	
5	SEAT Y ACCEL	ENDEVCO 7264-200	CF48H	2.915 mv/G	10.00 / 5	- / -	85.8 / -	1K / -	10G	120	0V / +2.5 -2.5	-	-	
6	HEAD X ACCEL	ENTRAN EGE-72B-200	93C19-R04	2.385 mv/G	10.00 / 6	- / -	21.0 / -	1K / -	50G	120	0V / +2.5 -2.5	-	-	
7	HEAD Y ACCEL	ENTRAN EGE-72B-200	93C19-R05	2.282 mv/G	10.00 / 7	- / -	54.8 / -	1K / -	20G	120	0V / +2.5 -2.5	-	-	
8	HEAD Z ACCEL	ENTRAN EGE-72B-200	93C19-R06	2.348 mv/G	10.00 / 8	- / -	35.5 / -	1K / -	30G	120	0V / +2.5 -2.5	-	-	

EXCITATION VOLTAGE NOTE:
CHANNELS 17-44 AND 49-52 ARE AT 5 VOLTS;
SENSITIVITIES ARE GIVEN FOR 10 VOLTS.

TABLE A-2a: DIGITAL INSTRUMENTATION REQUIREMENTS (PAGE 1 OF 6)

DYNCORP DIGITAL INSTRUMENTATION REQUIREMENTS

PROGRAM INVESTIGATION OF THE EFFECTS OF GENDER AND ANTHROPOMETRY ON DYNAMIC RESPONSE DURING -Gx IMPACT ACCELERATION (DRI STUDY)　　DATES: 26-SEP-95 THRU 15-DEC-95

FACILITY HORIZONTAL IMPULSE ACCELERATOR　　RUN NUMBERS: 5547 - 5697

DATA CHAN	DATA POINT	XDUCER MFG & TYPE	SERIAL NUMBER *	XDUCER SENS	EXCITE VOLT CHAN	FILTER SERIES S/N	AMP GAIN S/N	SAMPLE RATE FORMAT	FULL SCALE SENS	FILTER HZ	XDUCER ZERO RANGE	BRIDGE BALANCE RES	BRIDGE COMP RES	SPECIAL NOTATIONS
9	HEAD Ry ACCEL	ENDEVCO 7302B	H74P	3.818 μv/RAD/SEC²	10.00 9	- -	218.3 -	1K -	3000 RAD/SEC²	120	0V +2.5 -2.5	-	-	
10	CHEST X ACCEL	ENTRAN EGE-72B-200	93C19-R11	2.263 mv/G	10.00 10	- -	22.1 -	1K -	50G	120	0V +2.5 -2.5	-	-	
11	CHEST Y ACCEL	ENTRAN EGE-72B-200	93C19-R12	2.352 mv/G	10.00 11	- -	53.1 -	1K -	20G	120	0V +2.5 -2.5	-	-	
12	CHEST Z ACCEL	ENTRAN EGE-72B-200	93C19-R13	2.380 mv/G	10.00 12	- -	35.0 -	1K -	30G	120	0V +2.5 -2.5	-	-	
13	CHEST Ry ACCEL	ENDEVCO 7302B	F93M	3.712 μv/RAD/SEC²	10.00 13	- -	336.7 -	1K -	2000 RAD/SEC²	120	0V +2.5 -2.5	-	-	
14	T1 X ACCEL	ENTRAN EGAXT-100	87E87D29-V18	1.009 mv/G	10.00 14	- -	61.9 -	1K -	40G	120	0V +2.5 -2.5	-	-	
15	T1 Y ACCEL	ENTRAN EGAXT-100	87E87D29-V14	1.030 mv/G	10.00 15	- -	121.4 -	1K -	20G	120	0V +2.5 -2.5	-	-	
16	T1 Z ACCEL	ENTRAN EGAXT-100	87E87D29-V17	1.003 mv/G	10.00 16	- -	83.1 -	1K -	30G	120	0V +2.5 -2.5	-	-	
18	HEADREST X FORCE	AAMRL/DYN 3D-SW	21Z	6.21 μv/LB@10v	5.00 18	- -	402.6 -	1K -	2000LB	120	0V +2.5 -2.5	-	-	

TABLE A-2b: DIGITAL INSTRUMENTATION REQUIREMENTS (PAGE 2 OF 6)

DYNCORP DIGITAL INSTRUMENTATION REQUIREMENTS

PROGRAM INVESTIGATION OF THE EFFECTS OF GENDER AND ANTHROPOMETRY ON DYNAMIC RESPONSE DURING -Gx IMPACT ACCELERATION (DRI STUDY) DATES: 26-SEP-95 THRU 15-DEC-95

FACILITY HORIZONTAL IMPULSE ACCELERATOR RUN NUMBERS: 5547 - 5697

DATA CHAN	DATA POINT	XDUCER MFG & TYPE	SERIAL NUMBER	XDUCER SENS	EXCITE VOLT CHAN	FILTER SERIES S/N	AMP GAIN S/N	SAMPLE RATE FORMAT	FULL SCALE SENS	FILTER HZ	XDUCER ZERO RANGE	BRIDGE BALANCE RES	BRIDGE COMP RES	SPECIAL NOTATIONS
19	HEADREST Y FORCE	AAMRL/DYN 3D-SW	21Y	4.96 µv/LB@10v	5.00 19	- -	999 -	1K -	1000LB	120	0V +2.5 -2.5	10K +IN TO GND	-	
20	HEADREST Z FORCE	AAMRL/DYN 3D-SW	21X	5.22 µv/LB@10v	5.00 20	- -	957.9 -	1K -	1000LB	120	0V +2.5 -2.5	10K +IN TO GND	-	
21	LEFT LAP X FORCE	AAMRL/DYN 3D-SW	24Z	7.86 µv/LB@10v	5.00 21	- -	212 -	1K -	3000LB	120	0V +2.5 -2.5	-	-	TEST 5547-5616, MICH-SCIENTIFIC SN 2Z, SENS. 14.01µv/LB@10v EXC; GAIN 59.5
22	LEFT LAP Y FORCE	AAMRL/DYN 3D-SW	24Y	7.01 µv/LB@10v	5.00 22	- -	356.6 -	1K -	2000LB	120	0V +2.5 -2.5	-	-	TEST 5547-5616, MICH-SCIENTIFIC SN 2Y, SENS. 13.57µv/LB@10v EXC; GAIN 92.1
23	LEFT LAP Z FORCE	AAMRL/DYN 3D-SW	24X	7.36 µv/LB@10v	5.00 23	- -	226.4 -	1K -	3000LB	120	0V +2.5 -2.5	-	-	TEST 5547-5616, MICH-SCIENTIFIC SN 2X, SENS. 14.14µv/LB@10v EXC; GAIN 88.4 F.S.@2000LB
24	RIGHT LAP X FORCE	AAMRL/DYN 3D-SW	22Z	7.82 µv/LB@10v	5.00 24	- -	106.6 -	1K -	6000LB	120	0V +2.5 -2.5	-	-	
25	RIGHT LAP Y FORCE	AAMRL/DYN 3D-SW	22Y	7.10 µv/LB@10v	5.00 25	- -	176.1 -	1K -	4000LB	120	0V +2.5 -2.5	-	-	
26	RIGHT LAP Z FORCE	AAMRL/DYN 3D-SW	22X	6.85 µv/LB@10v	5.00 26	- -	182.5 -	1K -	4000LB	120	0V +2.5 -2.5	-	-	

TABLE A-2c: DIGITAL INSTRUMENTATION REQUIREMENTS (PAGE 3 OF 6)

DYNCORP DIGITAL INSTRUMENTATION REQUIREMENTS

PROGRAM INVESTIGATION OF THE EFFECTS OF GENDER AND ANTHROPOMETRY ON DYNAMIC RESPONSE DURING -Gx IMPACT ACCELERATION (DRI STUDY) DATES: 26-SEP-95 THRU 15-DEC-95

FACILITY HORIZONTAL IMPULSE ACCELERATOR RUN NUMBERS: 5547 - 5697

DATA CHAN	DATA POINT	XDUCER MFG & TYPE	SERIAL NUMBER	XDUCER SENS	EXCITE VOLT CHAN	FILTER SERIES S/N	AMP GAIN S/N	SAMPLE RATE FORMAT	FULL SCALE SENS	FILTER HZ	XDUCER ZERO RANGE	BRIDGE BALANCE RES	BRIDGE COMP RES	SPECIAL NOTATIONS
27	LEFT SHOULDER X FORCE	AAMRL/DYN 3D-SW	23Z	8.02 µv/LB@10v	5.00 27	- -	103.9 -	1K -	6000LB	120	0V +2.5 -2.5	100K +IN TO GND	-	
28	LEFT SHOULDER Y FORCE	AAMRL/DYN 3D-SW	23Y	7.24 µv/LB@10v	5.00 28	- -	345.3 -	1K -	2000LB	120	0V +2.5 -2.5	-	-	
29	LEFT SHOULDER Z FORCE	AAMRL/DYN 3D-SW	23X	6.99 µv/LB@10v	5.00 29	- -	178.8 -	1K -	4000LB	120	0V +2.5 -2.5	-	-	
30	RIGHT SHOULDER X FORCE	AAMRL/DYN 3D-SW	25Z	7.89 µv/LB@10v	5.00 30	- -	105.6 -	1K -	6000LB	120	0V +2.5 -2.5	-	-	
31	RIGHT SHOULDER Y FORCE	AAMRL/DYN 3D-SW	25Y	7.33 µv/LB@10v	5.00 31	- -	341.1 -	1K -	2000LB	120	0V +2.5 -2.5	20K -IN TO GND	-	
32	RIGHT SHOULDER Z FORCE	AAMRL/DYN 3D-SW	25X	6.99 µv/LB@10v	5.00 32	- -	178.8 -	1K -	4000LB	120	0V +2.5 -2.5	-	-	
33	LEFT SEAT BACK X FORCE	STRAINSERT FL2.5U-2SPKT	3294-2	7.98 µv/LB@10v	5.00 33	- -	313.3 -	1K -	2000LB	120	0V +2.5 -2.5	-	-	
34	RIGHT SEAT BACK X FORCE	STRAINSERT FL2.5U-2SPKT	3294-3	7.99 µv/LB@10v	5.00 34	- -	156.4 -	1K -	4000LB	120	0V +2.5 -2.5	-	-	
35	CENTER SEAT BACK X FORCE	STRAINSERT FL2.5U-2SPKT	3294-4	8.00 µv/LB@10v	5.00 35	- -	312.5 -	1K -	2000LB	120	0V +2.5 -2.5	-	-	

TABLE A-2d: DIGITAL INSTRUMENTATION REQUIREMENTS (PAGE 4 OF 6)

DYNCORP DIGITAL INSTRUMENTATION REQUIREMENTS

PROGRAM INVESTIGATION OF THE EFFECTS OF GENDER AND ANTHROPOMETRY ON DYNAMIC RESPONSE DURING -Gx IMPACT ACCELERATION (DRI STUDY)

DATES: 26-SEP-95 THRU 15-DEC-95

FACILITY HORIZONTAL IMPULSE ACCELERATOR

RUN NUMBERS: 5547 - 5697

DATA CHAN	DATA POINT	XDUCER MFG & TYPE	SERIAL NUMBER	XDUCER SENS	EXCITE VOLT CHAN	FILTER SERIES S/N	AMP GAIN S/N	SAMPLE RATE FORMAT	FULL SCALE SENS	FILTER HZ	XDUCER ZERO RANGE	BRIDGE BALANCE RES	BRIDGE COMP RES	SPECIAL NOTATIONS
36	TOP SEAT BACK LINK Y FORCE	MM/DYN EA-06-062TJ-350	003	11.34 µv/LB@10v	5.00 36	- -	220.5 -	1K -	2000LB	120	0V +2.5 -2.5	-	-	
37	BOTTOM SEAT BACK LINK Y FORCE	MM/DYN EA-06-062TJ-350	5	-10.15 µv/LB@10v	5.00 37	- -	246.3 -	1K -	2000LB	120	0V +2.5 -2.5	-	-	USE NEGATIVE SENSITIVITY
38	CENTER SEAT BACK LINK Z FORCE	MM/DYN EA-06-062TJ-350	4	10.08 µv/LB@10v	5.00 38	- -	248.0 -	1K -	2000LB	120	0V +2.5 -2.5	-	-	
39	LEFT SEAT PAN Z FORCE	STRAINSERT FL2.5U-2SGKT	7588-1	8.00 µv/LB@10v	5.00 39	- -	208.3 -	1K -	3000LB	120	0V +2.5 -2.5	-	-	
40	RIGHT SEAT PAN Z FORCE	STRAINSERT FL2.5U-2SGKT	7135-2	7.97 µv/LB@10v	5.00 40	- -	209.1 -	1K -	3000LB	120	0V +2.5 -2.5	-	-	
41	CENTER SEAT PAN Z FORCE	STRAINSERT FL2.5U-2SPKT	7135-3	7.97 µv/LB@10v	5.00 41	- -	209.1 -	1K -	3000LB	120	0V +2.5 -2.5	-	-	
42	LEFT SEAT PAN LINK X FORCE	MM/DYN EA-06-062TJ-350	7	10.44 µv/LB@10v	5.00 42	- -	239.5 -	1K -	3000LB	120	0V +2.5 -2.5	-	-	
43	RIGHT SEAT PAN LINK X FORCE	MM/DYN EA-06-062TJ-350	8	-10.35 µv/LB@10v	5.00 43	- -	241.5 -	1K -	2000LB	120	0V +2.5 -2.5	-	-	USE NEGATIVE SENSITIVITY
44	CENTER SEAT PAN LINK Y FORCE	MM/DYN EA-06-062TJ-350	9	11.00 µv/LB@10v	5.00 44	- -	227.3 -	1K -	2000LB	120	0V +2.5 -2.5	-	-	

TABLE A-2e: DIGITAL INSTRUMENTATION REQUIREMENTS (PAGE 5 OF 6)

DYNCORP DIGITAL INSTRUMENTATION REQUIREMENTS

PROGRAM INVESTIGATION OF THE EFFECTS OF GENDER AND ANTHROPOMETRY ON DYNAMIC RESPONSE DURING -Gx IMPACT ACCELERATION (DRI STUDY) DATES: 26-SEP-95 THRU 15-DEC-95

FACILITY HORIZONTAL IMPULSE ACCELERATOR RUN NUMBERS: 5547 - 5697

DATA CHAN	DATA POINT	XDUCER MFG & TYPE	SERIAL NUMBER	XDUCER SENS	EXCITE VOLT / CHAN	FILTER SERIES / S/N	AMP GAIN / S/N	SAMPLE RATE / FORMAT	FULL SCALE SENS	FILTER HZ	XDUCER ZERO / RANGE	BRIDGE BALANCE RES	BRIDGE COMP RES	SPECIAL NOTATIONS
45	VELOCITY	GLOBE 22A672-2	2	.02172 V/F/S	- / 45	- / -	1 / -	1K / -	115.1 F/S	120	0V / +2.5 -2.5	-	-	RAW SENSITIVITY OF TACH = 0.1516V/REV/SEC; 0.1766V/F/S @ 10.3" CIR WHEEL; ATTENUATOR @ 8.130 ∴ 0.1766V/F/S/8.130 = 0.02172V/F/S
46	LEFT FOOT X FORCE	MICH-SCIEN 4000	4Z	-13.72 µv/LB	10.00 / 46	- / -	182.2 / -	1K / -	1000LB	120	0V / +2.5 -2.5	-	-	USE NEGATIVE SENSITIVITY; TEST 5547-5550, F.S.=500LB GAIN@364.4
47	LEFT FOOT Y FORCE	MICH-SCIEN 4000	4Y	-13.88 µv/LB	10.00 / 47	- / -	360.2 / -	1K / -	500LB	120	0V / +2.5 -2.5	-	-	USE NEGATIVE SENSITIVITY
48	LEFT FOOT Z FORCE	MICH-SCIEN 4000	4X	13.43 µv/LB	10.00 / 48	- / -	186.2 / -	1K / -	1000LB	120	0V / +2.5 -2.5	-	-	TEST 5547-5550, F.S.=500LB, GAIN@372.3
49	RIGHT FOOT X FORCE	MICH-SCIEN 4000	5Z	-13.75 µv/LB@10v	5.00 / 49	- / -	363.6 / -	1K / -	1000LB	120	0V / +2.5 -2.5	-	-	USE NEGATIVE SENSITIVITY; TEST 5547-5550, F.S.=500LB
50	RIGHT FOOT Y FORCE	MICH-SCIEN 4000	5Y	-14.17 µv/LB@10v	5.00 / 50	- / -	352.9 / -	1K / -	1000LB	120	0V / +2.5 -2.5	-	-	USE NEGATIVE SENSITIVITY
51	RIGHT FOOT Z FORCE	MICH-SCIEN 4000	5X	13.72 µv/LB@10v	5.00 / 51	- / -	364.4 / -	1K / -	1000LB	120	0V / +2.5 -2.5	-	-	TEST 5547-5550, F.S.=500LB

TABLE A-2f: DIGITAL INSTRUMENTATION REQUIREMENTS (PAGE 6 OF 6)

MANUFACTURER	MODEL	RANGE	SENSITIVITY (mv)	RESONANCE FREQ (Hz)	FREQUENCY RESPONSE (Hz)	EXCITATION (Volt)	2 ARM or 4 ARM	ADDITIONAL NOTES
ENDEVCO	2262A-200	± 200 G	2.5/G	7000	0-2000	10	4 ARM	LINEAR ACCELEROMETER
ENDEVCO	7302B	± 50,000 RAD/SEC^2	.004 /RAD/SEC^2	3000	1-600	10	4 ARM	ANGULAR ACCELEROMETER X10 OVERRANGE
ENDEVCO	7264-200	± 200 G	2.5/G	6000	0-1200	10	2 ARM	LINEAR ACCELEROMETER
ENTRAN	EGAXT-100	± 100 G	2.0/G	1700	600	10	4 ARM	LINEAR ACCELEROMETER
ENTRAN	EGE-72B-200	± 200 G	2.5/G	6000	0-1000	10	4 ARM	LINEAR ACCELEROMETER X10 OVERRANGE 0.7 DAMPING
STRAINSERT	FL2.5U-2SPKT & 2SGKT	± 2500 LB	.008/LB	3600	0-2000	10	4 ARM	LOAD CELL 15 V MAX EXC. 5 K LB MAX. OVERRANGE

TABLE A-3: TYPICAL TRANSDUCER SPECIFICATIONS

DYNCORP PROGRAM CALIBRATION LOG

PROGRAM: INVESTIGATION OF THE EFFECTS OF GENDER AND ANTHROPOMETRY ON DYNAMIC RESPONSE DURING -Gx IMPACT ACCELERATION (DRI STUDY)

DATES: 26-SEP-95 THRU 15-DEC-95

FACILITY: HORIZONTAL IMPULSE ACCELERATOR

RUN NUMBERS: 5547 - 5697

DATA POINT	TRANSDUCER MFG. & MODEL	SERIAL NUMBER	PRE - CAL		POST - CAL		%CHANGE	NOTES
			DATE	SENS	DATE	SENS		
SLED X ACCEL.	ENDEVCO 2262A-200	FR42	14-SEP-95	4.208 mv/G	21-DEC-95	4.260 mv/G	+1.2	
SLED Y ACCEL.	ENTRAN EGE-72B-200	93C19-R07	14-SEP-95	2.448 mv/G	21-DEC-95	2.412 mv/G	-1.5	
SLED Z ACCEL.	ENTRAN EGE-72B-200	93C19-R02	14-SEP-95	2.277 mv/G	21-DEC-95	2.248 mv/G	-1.3	
SEAT X ACCEL.	ENTRAN EGE-72B-200	93C19-R14	18-SEP-95	2.290 mv/G	21-DEC-95	2.280 mv/G	-0.4	
SEAT Y ACCEL.	ENDEVCO 7264-200	CF48H	18-SEP-95	2.915 mv/G	21-DEC-95	2.910 mv/G	-0.2	
HEAD X ACCEL.	ENTRAN EGE-72B-200	93C19-R04	15-SEP-95	2.385 mv/G	20-DEC-95	2.364 mv/G	-0.9	
HEAD Y ACCEL.	ENTRAN EGE-72B-200	93C19-R05	15-SEP-95	2.282 mv/G	20-DEC-95	2.255 mv/G	-1.2	
HEAD Z ACCEL.	ENTRAN EGE-72B-200	93C19-R06	15-SEP-95	2.348 mv/G	20-DEC-95	2.319 mv/G	-1.2	
HEAD Ry ACCEL.	ENDEVCO 7302B	H74P	18-SEP-95	3.818 μv/RAD/SEC^2	19-DEC-95	3.797 μv/RAD/SEC^2	-0.6	
CHEST X ACCEL.	ENTRAN EGE-72B-200	93C19-R11	15-SEP-95	2.263 mv/G	19-DEC-95	2.247 mv/G	-0.7	
CHEST Y ACCEL.	ENTRAN EGE-72B-200	93C19-R12	15-SEP-95	2.352 mv/G	19-DEC-95	2.340 mv/G	-0.5	
CHEST Z ACCEL.	ENTRAN EGE-72B-200	93C19-R13	15-SEP-95	2.380 mv/G	19-DEC-95	2.361 mv/G	-0.8	
CHEST Ry ACCEL.	ENDEVCO 7302B	F93M	18-SEP-95	3.712 μv/RAD/SEC^2	19-DEC-95	3.689 μv/RAD/SEC^2	-0.6	
T1 X ACCEL.	ENTRAN EGAXT-100	87E87D29-V18	18-SEP-95	1.009 mv/G	20-DEC-95	1.008 mv/G	-0.2	

TABLE A-4a: TRANSDUCER PRE- AND POST-CALIBRATION (PAGE 1 OF 4)

DYNCORP PROGRAM CALIBRATION LOG

PROGRAM: INVESTIGATION OF THE EFFECTS OF GENDER AND ANTHROPOMETRY ON DYNAMIC RESPONSE DURING -Gx IMPACT ACCELERATION (DRI STUDY)

DATES: 26-SEP-95 THRU 15-DEC-95

FACILITY: HORIZONTAL IMPULSE ACCELERATOR

RUN NUMBERS: 5547 - 5697

DATA POINT	TRANSDUCER MFG. & MODEL	SERIAL NUMBER	PRE - CAL		POST - CAL		%CHANGE	NOTES
			DATE	SENS	DATE	SENS		
T1 Y ACCEL.	ENTRAN EGAXT-100	87E87D29-V14	18-SEP-95	1.030 mv/G	20-DEC-95	0.986 mv/G	-4.3	
T1 Z ACCEL.	ENTRAN EGAXT-100	87E87D29-V17	18-SEP-95	1.003 mv/G	20-DEC-95	1.011 mv/G	+0.8	
HEADREST X FORCE	AAMRL/DYN 3D-SW	21Z	13-SEP-95	6.21 μv/LB	22-DEC-95	6.21 μv/LB	0	
HEADREST Y FORCE	AAMRL/DYN 3D-SW	21Y	13-SEP-95	4.96 μv/LB	22-DEC-95	4.93 μv/LB	-0.6	
HEADREST Z FORCE	AAMRL/DYN 3D-SW	21X	13-SEP-95	5.22 μv/LB	22-DEC-95	5.19 μv/LB	-0.6	
LEFT LAP X FORCE	MICH.-SCIENTIFIC 2000	2Z	14-SEP-95	14.01 μv/LB	20-OCT-95	13.78 μv/LB	-1.6	TEST 5547-5616 ONLY
LEFT LAP Y FORCE	MICH.-SCIENTIFIC 2000	2Y	14-SEP-95	13.57 μv/LB	20-OCT-95	13.53 μv/LB	-0.3	TEST 5547-5616 ONLY
LEFT LAP Z FORCE	MICH.-SCIENTIFIC 2000	2X	14-SEP-95	14.14 μv/LB	20-OCT-95	14.10 μv/LB	-0.3	TEST 5547-5616 ONLY
RIGHT LAP X FORCE	AAMRL/DYN 3D-SW	22Z	13-SEP-95	7.82 μv/LB	27-DEC-95	7.77 μv/LB	-0.6	
RIGHT LAP Y FORCE	AAMRL/DYN 3D-SW	22Y	13-SEP-95	7.10 μv/LB	27-DEC-95	7.07 μv/LB	-0.4	
RIGHT LAP Z FORCE	AAMRL/DYN 3D-SW	22X	13-SEP-95	6.85 μv/LB	27-DEC-95	6.82 μv/LB	-0.4	
LEFT SHOULDER X FORCE	AAMRL/DYN 3D-SW	23Z	13-SEP-95	8.02 μv/LB	27-DEC-95	7.97 μv/LB	-0.6	
LEFT SHOULDER Y FORCE	AAMRL/DYN 3D-SW	23Y	14-SEP-95	7.24 μv/LB	27-DEC-95	7.19 μv/LB	-0.7	
LEFT SHOULDER Z FORCE	AAMRL/DYN 3D-SW	23X	14-SEP-95	6.99 μv/LB	27-DEC-95	6.95 μv/LB	-0.6	

TABLE A-4b: TRANSDUCER PRE- AND POST-CALIBRATION (PAGE 2 OF 4)

DYNCORP PROGRAM CALIBRATION LOG

PROGRAM INVESTIGATION OF THE EFFECTS OF GENDER AND ANTHROPOMETRY ON DYNAMIC RESPONSE DURING -Gx IMPACT ACCELERATION (DRI STUDY)

DATES: 26-SEP-95 THRU 15-DEC-95

FACILITY HORIZONTAL IMPULSE ACCELERATOR

RUN NUMBERS: 5547 - 5697

DATA POINT	TRANSDUCER MFG. & MODEL	SERIAL NUMBER	PRE - CAL		POST - CAL		%CHANGE	NOTES
			DATE	SENS	DATE	SENS		
RIGHT SHOULDER X FORCE	AAMRL/DYN 3D-SW	25Z	14-SEP-95	7.89 μv/LB	27-DEC-95	7.84 μv/LB	-0.6	
RIGHT SHOULDER Y FORCE	AAMRL/DYN 3D-SW	25Y	14-SEP-95	7.33 μv/LB	27-DEC-95	7.31 μv/LB	-0.3	
RIGHT SHOULDER Z FORCE	AAMRL/DYN 3D-SW	25X	14-SEP-95	6.99 μv/LB	27-DEC-95	6.96 μv/LB	-0.4	
TOP SEAT BACK LINK Y FORCE	MM/DYN EA-06-062TJ-350	003	13-SEP-95	11.34 μv/LB	22-DEC-95	11.35 μv/LB	+0.1	
BOTTOM SEAT BACK LINK Y FORCE	MM/DYN EA-06-062TJ-350	5	13-SEP-95	10.15 μv/LB	22-DEC-95	10.19 μv/LB	+0.4	
CENTER SEAT BACK LINK Z FORCE	MM/DYN EA-06-062TJ-350	4	13-SEP-95	10.08 μv/LB	22-DEC-95	10.13 μv/LB	+0.5	
LEFT SEAT PAN LINK X FORCE	MM/DYN EA-06-062TJ-350	7	13-SEP-95	10.44 μv/LB	22-DEC-95	10.51 μv/LB	+0.7	
RIGHT SEAT PAN LINK X FORCE	MM/DYN EA-06-062TJ-350	8	13-SEP-95	10.35 μv/LB	22-DEC-95	10.40 μv/LB	+0.5	
CENTER SEAT PAN LINK Y FORCE	MM/DYN EA-06-062TJ-350	9	13-SEP-95	11.00 μv/LB	22-DEC-95	10.89 μv/LB	-1.0	
LEFT FOOT X FORCE	MICH.-SCIENTIFIC 4000	4Z	14-SEP-95	13.72 μv/LB	28-DEC-95	13.65 μv/LB	-0.5	
LEFT FOOT Y FORCE	MICH.-SCIENTIFIC 4000	4Y	14-SEP-95	13.88 μv/LB	28-DEC-95	13.81 μv/LB	-0.5	
LEFT FOOT Z FORCE	MICH.-SCIENTIFIC 4000	4X	14-SEP-95	13.43 μv/LB	28-DEC-95	13.40 μv/LB	-0.2	
RIGHT FOOT X FORCE	MICH.-SCIENTIFIC 4000	5Z	14-SEP-95	13.75 μv/LB	27-DEC-95	13.72 μv/LB	-0.2	
RIGHT FOOT Y FORCE	MICH.-SCIENTIFIC 4000	5Y	14-SEP-95	14.17 μv/LB	27-DEC-95	14.18 μv/LB	+0.1	
RIGHT FOOT Z FORCE	MICH.-SCIENTIFIC 4000	5X	14-SEP-95	13.72 μv/LB	27-DEC-95	13.68 μv/LB	-0.3	

TABLE A-4c: TRANSDUCER PRE- AND POST-CALIBRATION (PAGE 3 OF 4)

DYNCORP PROGRAM CALIBRATION LOG

PROGRAM INVESTIGATION OF THE EFFECTS OF GENDER AND ANTHROPOMETRY ON DYNAMIC RESPONSE DURING -Gx IMPACT ACCELERATION (DRI STUDY)

DATES: 26-SEP-95 THRU 15-DEC-95

FACILITY HORIZONTAL IMPULSE ACCELERATOR

RUN NUMBERS: 5547 - 5697

DATA POINT	TRANSDUCER MFG. & MODEL	SERIAL NUMBER	PRE - CAL		POST - CAL		%CHANGE	NOTES
			DATE	SENS	DATE	SENS		
LEFT SEAT BACK X FORCE	STRAINSERT FL2.5U-2SPKT	3294-2	12-JAN-95	7.98 μv/LB	-	-	-	CALIBRATED PERIODICALLY BY PMEL
RIGHT SEAT BACK X FORCE	STRAINSERT FL2.5U-2SPKT	3294-3	09-JAN-95	7.99 μv/LB	-	-	-	CALIBRATED PERIODICALLY BY PMEL
CENTER SEAT BACK X FORCE	STRAINSERT FL2.5U-2SPKT	3294-4	12-JAN-95	8.00 μv/LB	-	-	-	CALIBRATED PERIODICALLY BY PMEL
LEFT SEAT PAN Z FORCE	STRAINSERT FL2.5U-2SGKT	7588-1	05-JAN-95	8.00 μv/LB	-	-	-	CALIBRATED PERIODICALLY BY PMEL
RIGHT SEAT PAN Z FORCE	STRAINSERT FL2.5U-2SPKT	7135-2	20-JAN-95	7.97 μv/LB	-	-	-	CALIBRATED PERIODICALLY BY PMEL
CENTER SEAT PAN Z FORCE	STRAINSERT FL2.5U-2SPKT	7135-3	09-JAN-95	7.97 μv/LB	-	-	-	CALIBRATED PERIODICALLY BY PMEL
VELOCITY	GLOBE 22A672-2	2	18-APR-94	0.02172 V/F/S	-	-	-	(12 IN/FT)/(10.3 IN/REV)X 0.1566 V/REV/SEC = 0.1766 V/F/S; 0.1766 V/F/S*1/8.130 = 0.02172 V/F/S; CALIBRATED PERIODICALLY BY DYNCORP PERSONNEL
LEFT LAP X FORCE	AAMRL/DYN 3D-SW	24Z	03-MAY-95	7.86 μv/LB	27-DEC-95	7.93 μv/LB	+0.9	TEST 5617-5697 ONLY
LEFT LAP Y FORCE	AAMRL/DYN 3D-SW	24Y	03-MAY-95	7.01 μv/LB	27-DEC-95	7.10 μv/LB	+1.3	TEST 5617-5697 ONLY
LEFT LAP Z FORCE	AAMRL/DYN 3D-SW	24X	03-MAY-95	7.36 μv/LB	27-DEC-95	7.42 μv/LB	+0.8	TEST 5617-5697 ONLY

TABLE A-4d: TRANSDUCER PRE- AND POST-CALIBRATION (PAGE 4 OF 4)

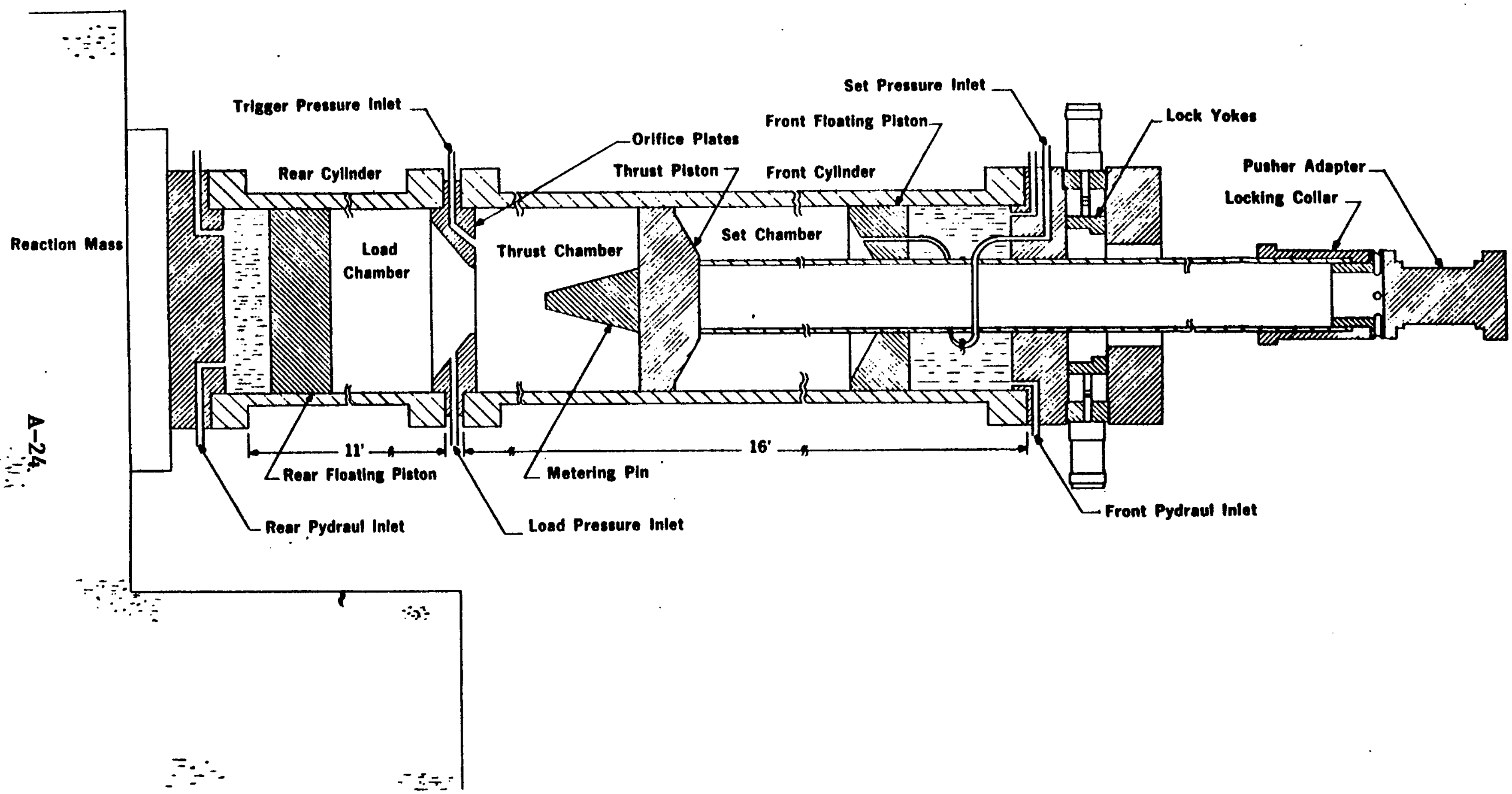


FIGURE A-1: HORIZONTAL IMPULSE ACCELERATOR ACTUATOR

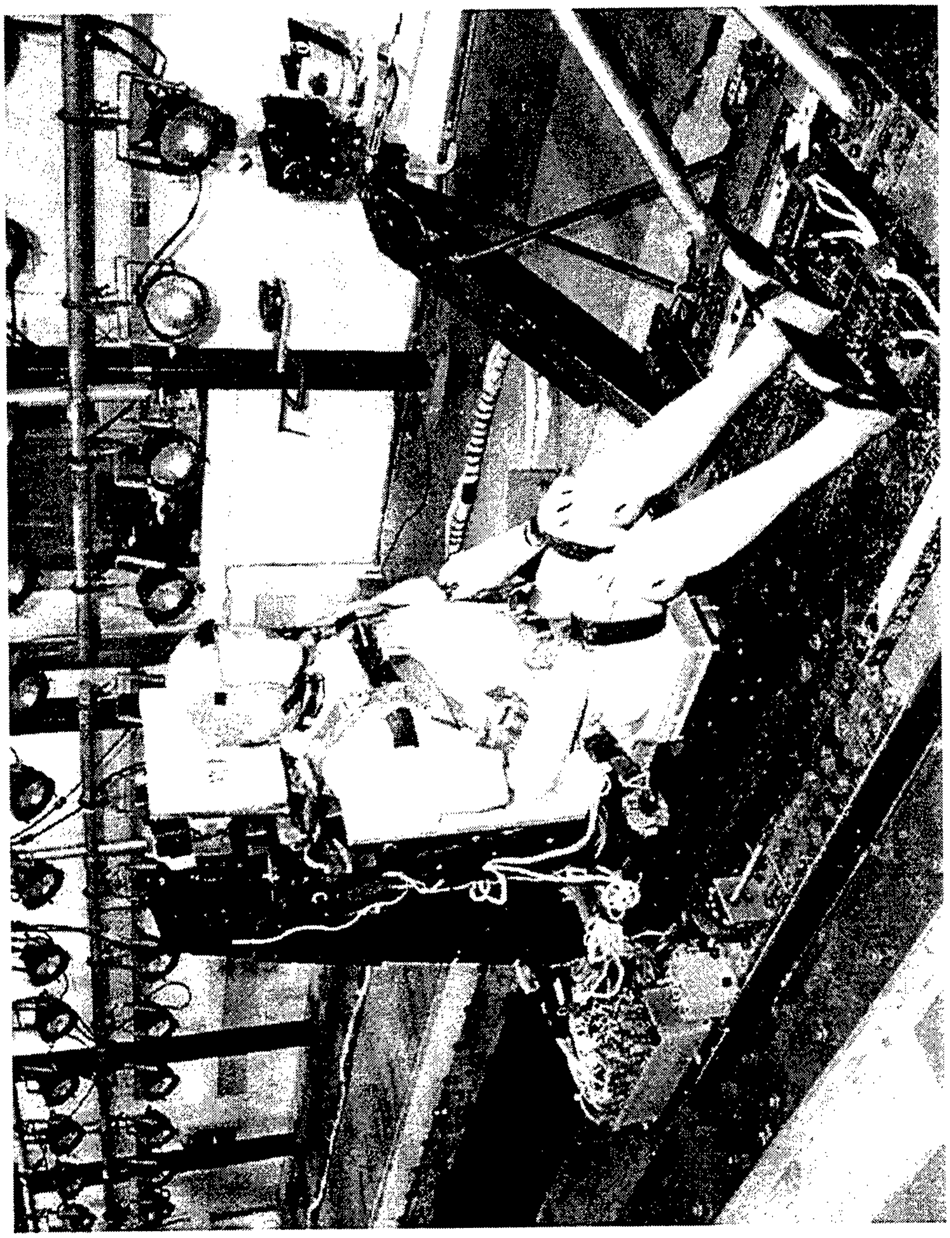
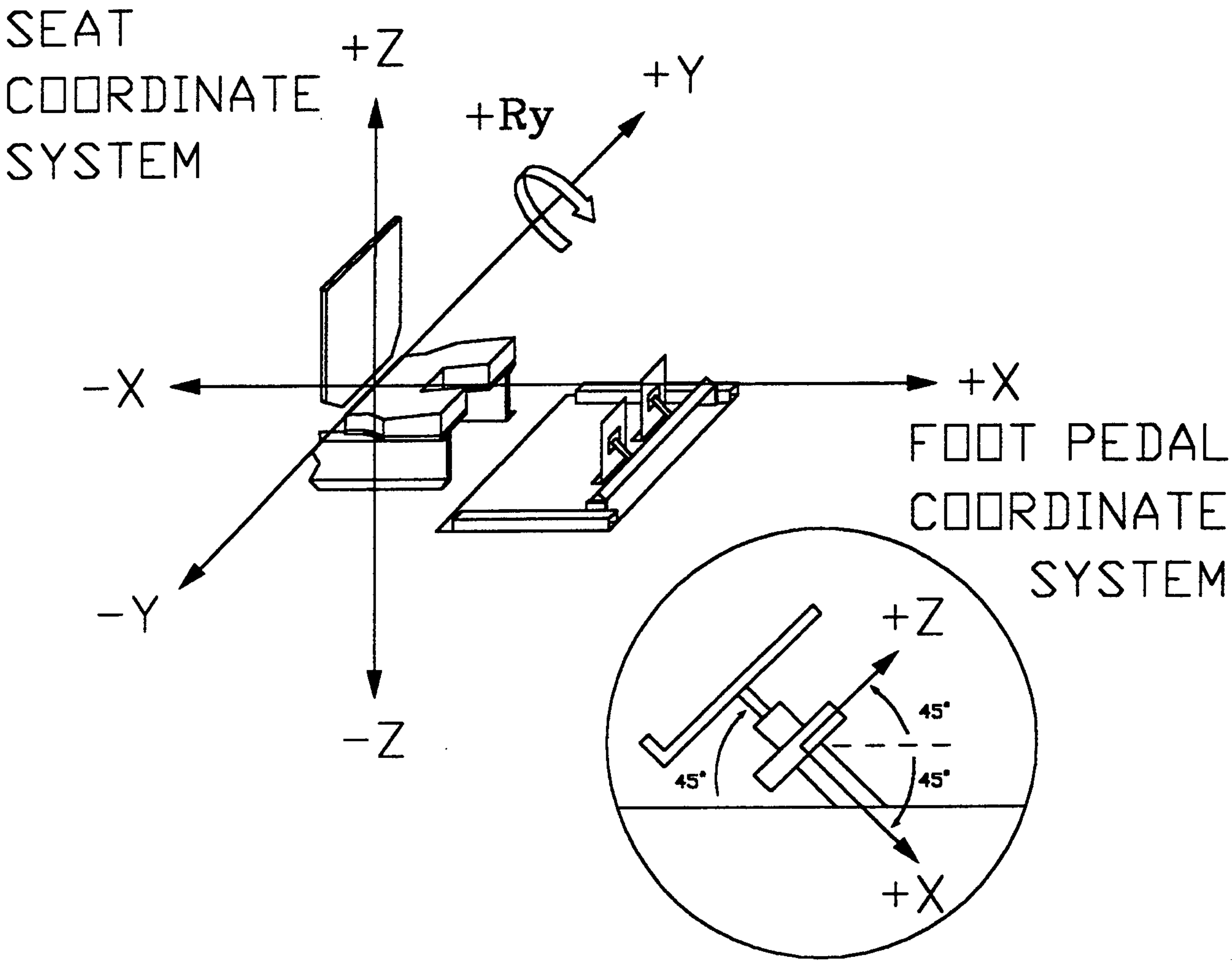


FIGURE A-2: SEAT FIXTURE



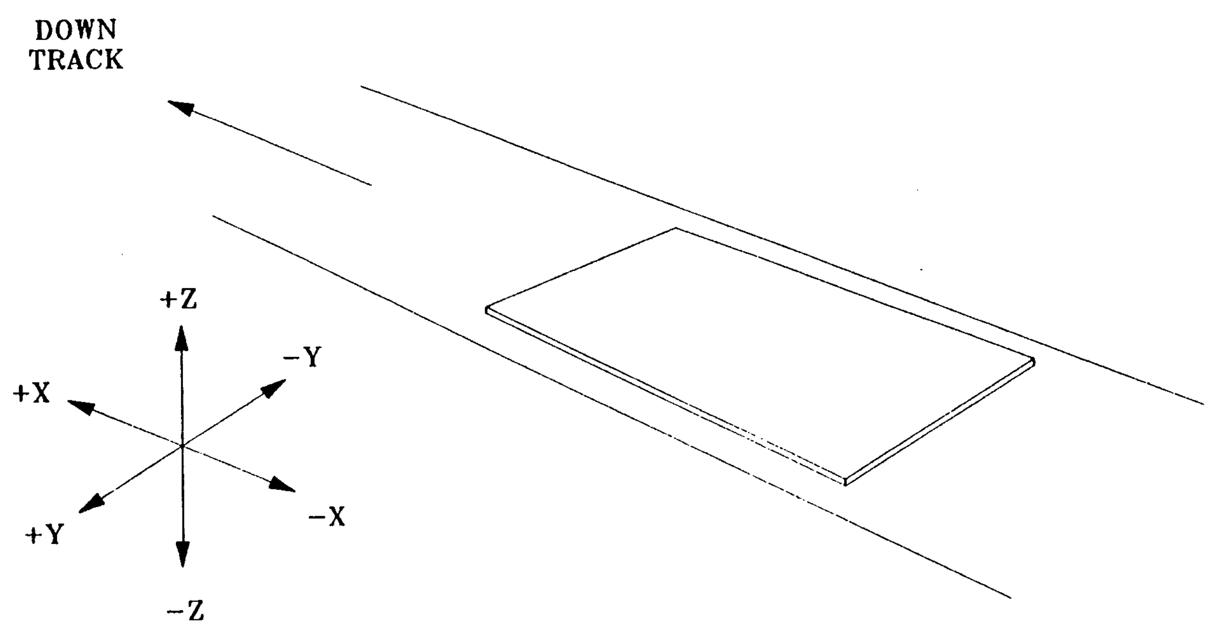
1. ALL TRANSDUCERS EXCEPT THE SLED ACCELEROMETERS, SLED VELOCITY TACHOMETER, AND THE FOOT LOAD CELLS WERE REFERENCED TO THE SEAT COORDINATE SYSTEM. THE FOOT LOAD CELLS WERE REFERENCED TO THE FOOT PETAL COORDINATE SYSTEM.

2. THE LINEAR ACCELEROMETERS WERE WIRED TO PROVIDE A POSITIVE OUTPUT VOLTAGE WHEN THE ACCELERATION EXPERIENCED BY THE ACCELEROMETER WAS APPLIED IN THE +x, +y OR +z DIRECTION AS SHOWN.

3. THE ANGULAR Ry ACCELEROMETERS WERE WIRED TO PROVIDE A POSITIVE OUTPUT VOLTAGE WHEN THE ANGULAR ACCELERATION EXPERIENCED BY THE ANGULAR ACCELEROMETER WAS APPLIED IN THE +y DIRECTION ACCORDING TO THE RIGHT HAND RULE AS SHOWN.

4. THE LOAD CELLS WERE WIRED TO PROVIDE A POSITIVE OUTPUT VOLTAGE WHEN THE FORCE EXERTED BY THE LOAD CELL ON THE SUBJECT WAS APPLIED IN THE +x, +y OR +z DIRECTION AS SHOWN.

FIGURE A-3: AL/CFBE COORDINATE SYSTEM



1. THE SLED LINEAR ACCELEROMETERS WERE WIRED TO PROVIDE A POSITIVE OUTPUT VOLTAGE WHEN THE ACCELERATION EXPERIENCED BY THE ACCELEROMETER IS APPLIED IN THE +x, +y OR +z DIRECTIONS AS SHOWN.

2. THE SLED VELOCITY TACHOMETER WAS WIRED TO PROVIDE A POSITIVE OUTPUT VOLTAGE WHEN THE SLED MOVES IN THE +x DIRECTION AS SHOWN.

FIGURE A-4: AL/CFBE SLED COORDINATE SYSTEM

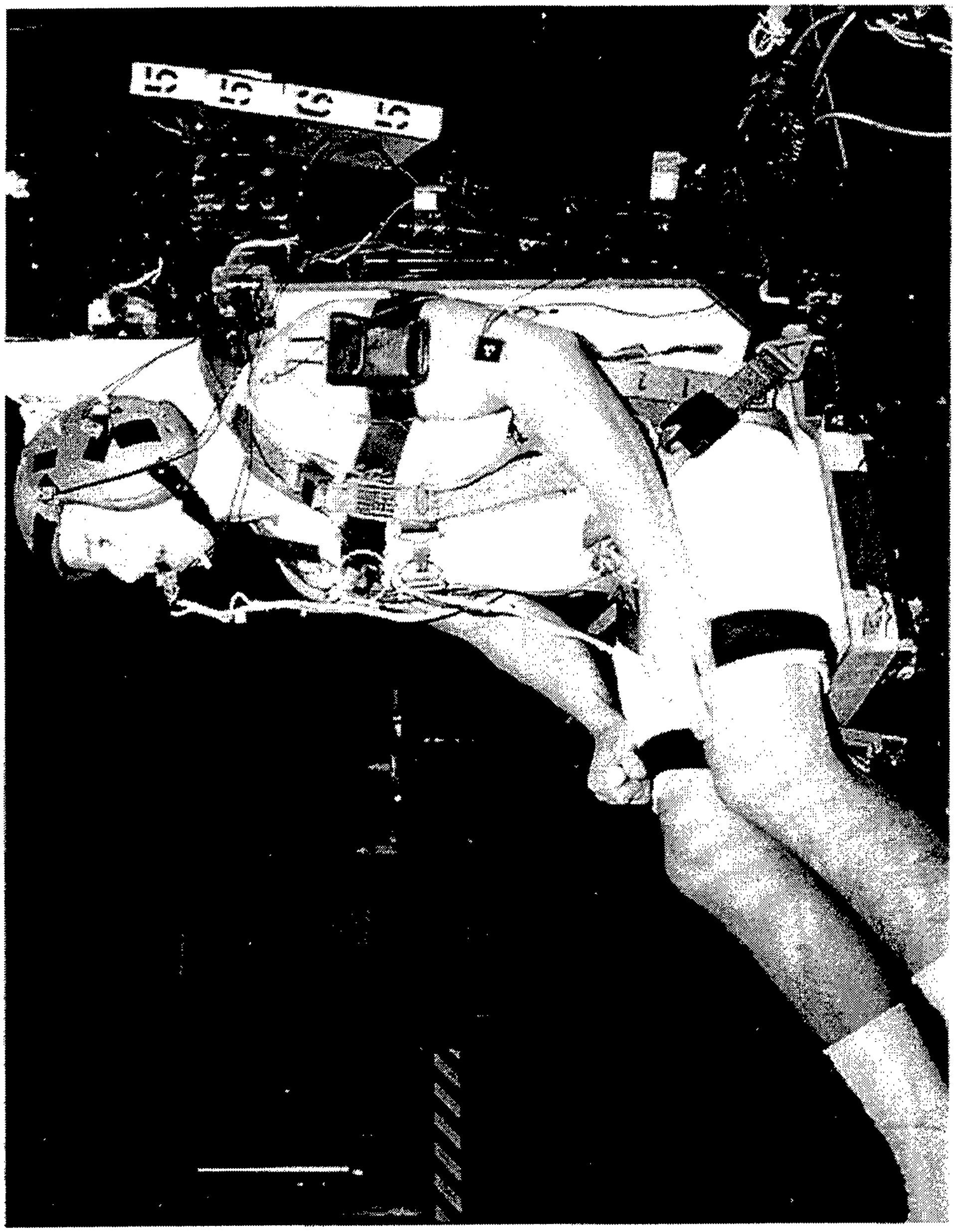


FIGURE A-5: EXTERNAL CHEST ACCELEROMETER PACKAGE

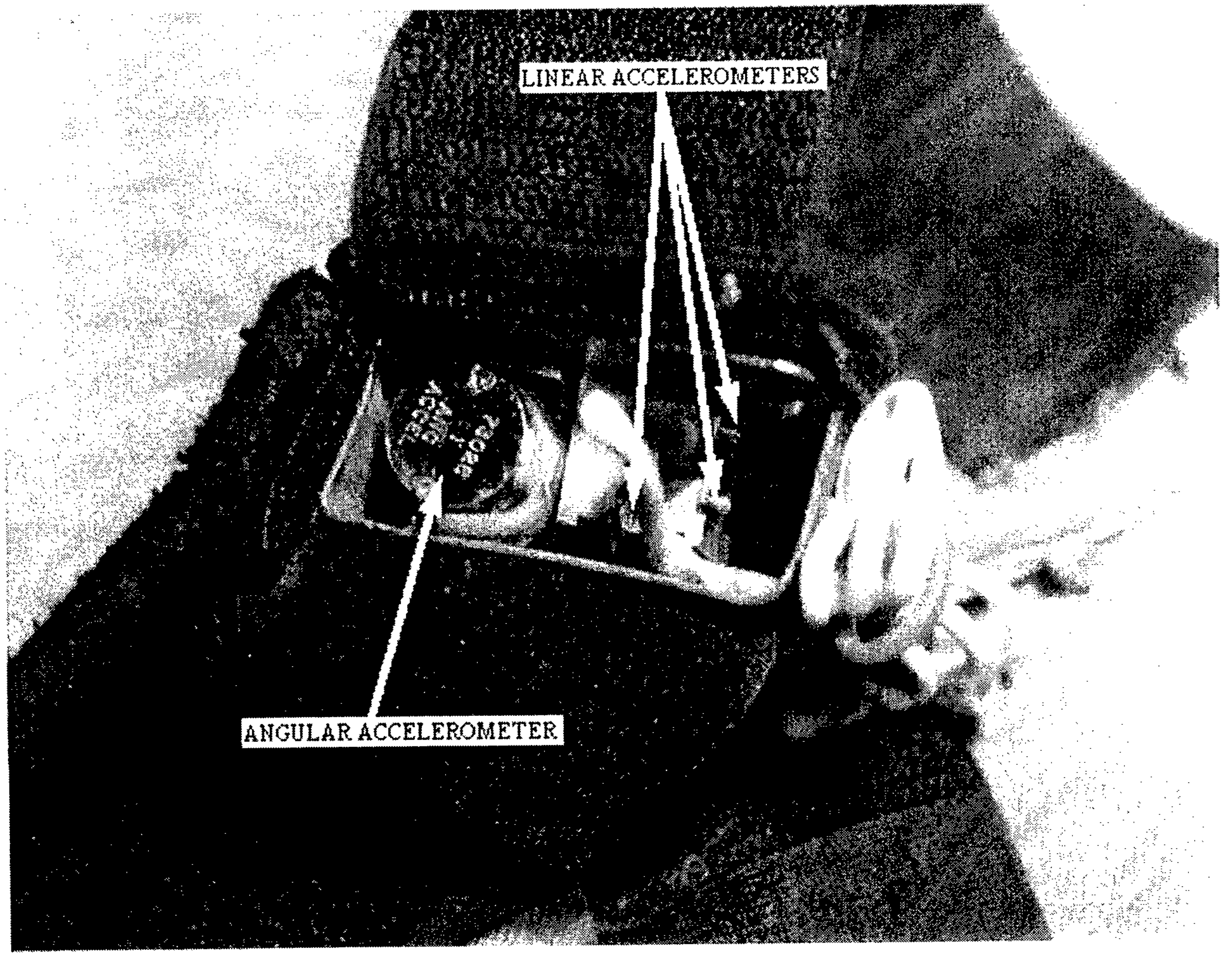


FIGURE A-6: EXTERNAL CHEST ACCELEROMETER PACKAGE

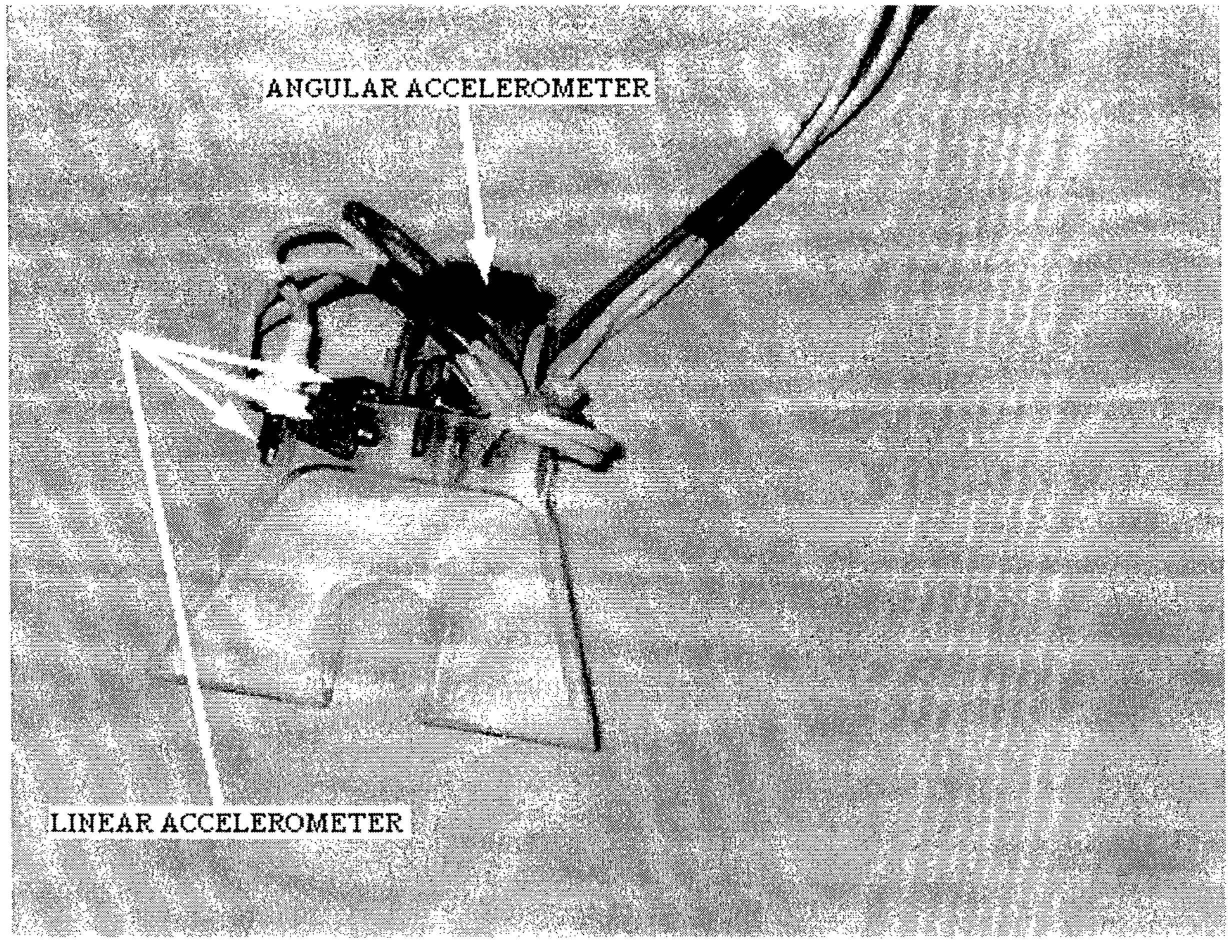
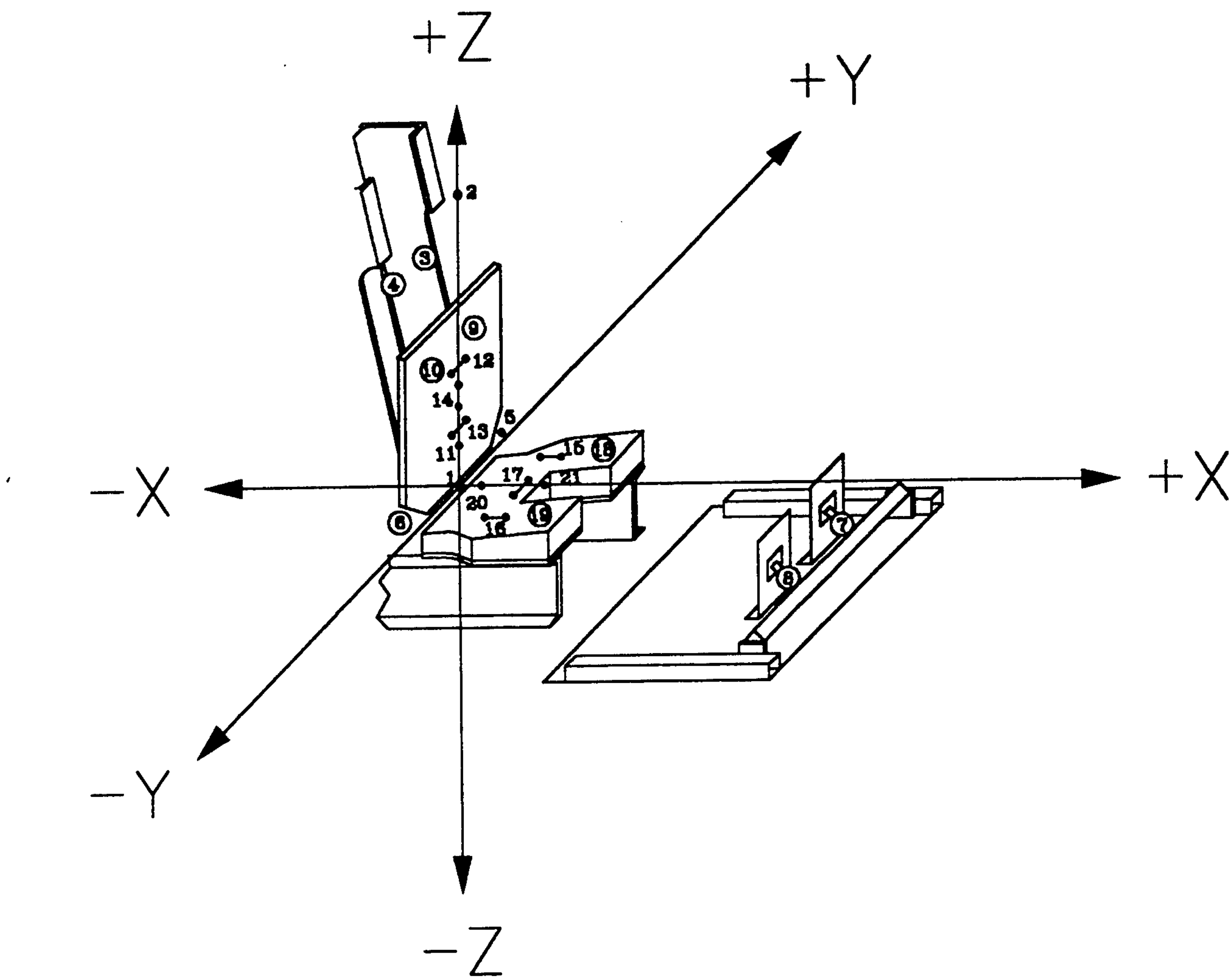


FIGURE A-7: HUMAN HEAD ACCELEROMETER PACKAGE



NO.	DESCRIPTION
1	SEAT REFERENCE POINT
2	HEAD FORCE
3	LEFT SHOULDER BELT FORCE
4	RIGHT SHOULDER BELT FORCE
5	LEFT LAP BELT FORCE
6	RIGHT LAP BELT FORCE
7	LEFT FOOT FORCE
8	RIGHT FOOT FORCE
9	LEFT SEAT BACK X FORCE
10	RIGHT SEAT BACK X FORCE
11	CENTER SEAT BACK X FORCE
12	TOP SEAT BACK LINK Y FORCE
13	BOTTOM SEAT BACK LINK Y FORCE
14	CENTER SEAT BACK LINK Z FORCE
15	LEFT SEAT PAN LINK X FORCE
16	RIGHT SEAT PAN LINK X FORCE
17	CENTER SEAT PAN LINK Y FORCE
18	LEFT SEAT PAN Z FORCE
19	RIGHT SEAT PAN Z FORCE
20	CENTER SEAT PAN Z FORCE
21	SEAT X AND Y ACCELEROMETER

FIGURE A-8a: TRANSDUCER LOCATIONS AND DIMENSIONS
(PAGE 1 OF 2)

ALL DIMENSIONS ARE REFERENCED TO THE SEAT REFERENCE POINT (SRP). THE SEAT REFERENCE POINT IS LOCATED AT THE INTERSECTION OF THE SEAT PAN CENTER LINE AND THE SEAT BACK CENTER LINE (z AXIS).

CONTACT POINT DIMENSIONS IN INCHES (CM)

NO.	X	Y	Z
1	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
2	- 6.85 (-17.39)	- 0.54 (- 1.37)	33.08 (84.03)
3	- 3.18 (- 8.07)	2.02 (5.14)	26.02 (66.10)
4	- 3.18 (- 8.07)	- 2.87 (- 7.28)	26.07 (66.21)
5	2.21 (5.61)	8.88 (22.56)	- 2.00 (- 5.08)
6	2.01 (5.11)	- 9.14 (-23.21)	- 2.11 (- 5.37)
7	44.22 (112.31)	5.98 (15.18)	- 7.50 (-19.06)
8	44.09 (112.00)	- 5.94 (-15.10)	- 7.52 (-19.11)
9	- 1.51 (- 3.83)	5.46 (13.87)	17.50 (44.46)
10	- 1.51 (- 3.83)	- 6.28 (-15.95)	17.33 (44.01)
11	- 1.51 (- 3.83)	- 1.98 (- 5.02)	5.24 (13.31)
12	- 2.10 (- 5.33)	- 2.36 (- 6.00)	17.44 (44.31)
13	- 2.10 (- 5.33)	3.28 (8.32)	9.42 (23.92)
14	- 2.10 (- 5.33)	- 0.34 (- 0.87)	14.62 (37.14)
15	13.54 (34.39)	6.19 (15.71)	- 3.14 (- 7.98)
16	13.42 (34.09)	- 5.90 (-14.99)	- 3.14 (- 7.98)
17	8.74 (22.19)	2.03 (5.15)	- 3.14 (- 7.98)
18	17.55 (44.58)	5.04 (12.80)	- 2.40 (- 6.10)
19	17.60 (44.71)	- 5.02 (-12.74)	- 2.40 (- 6.10)
20	6.30 (15.99)	0.17 (0.42)	- 2.40 (- 6.10)
21	13.64 (34.65)	0.17 (0.42)	- 4.70 (-11.95)

(SEE FIGURE A-8a FOR DESCRIPTIONS OF TRANSDUCER ITEM NUMBERS)

THE SEAT ACCELEROMETER MEASUREMENTS (ITEM 21) WERE TAKEN AT THE CENTER OF THE ACCELEROMETER BLOCK.

THE CONTACT POINT IS THE POINT ON THE LOAD CELL AT WHICH THE EXTERNAL FORCE IS APPLIED.

THE MEASUREMENTS FOR THE LOAD CELLS WHICH ANCHOR THE HARNESS (ITEMS 3, 4, 5 & 6) WERE TAKEN AT THE POINT WHERE THE HARNESS IS ATTACHED TO THE LOAD CELL.

THE MEASUREMENTS FOR THE FOOT LOAD CELLS (ITEMS 7 & 8) WERE TAKEN IN POSITION 1 (REFERENCE FIGURE A-9).

FIGURE A-8b: TRANSDUCER LOCATIONS AND DIMENSIONS
(PAGE 2 OF 2)

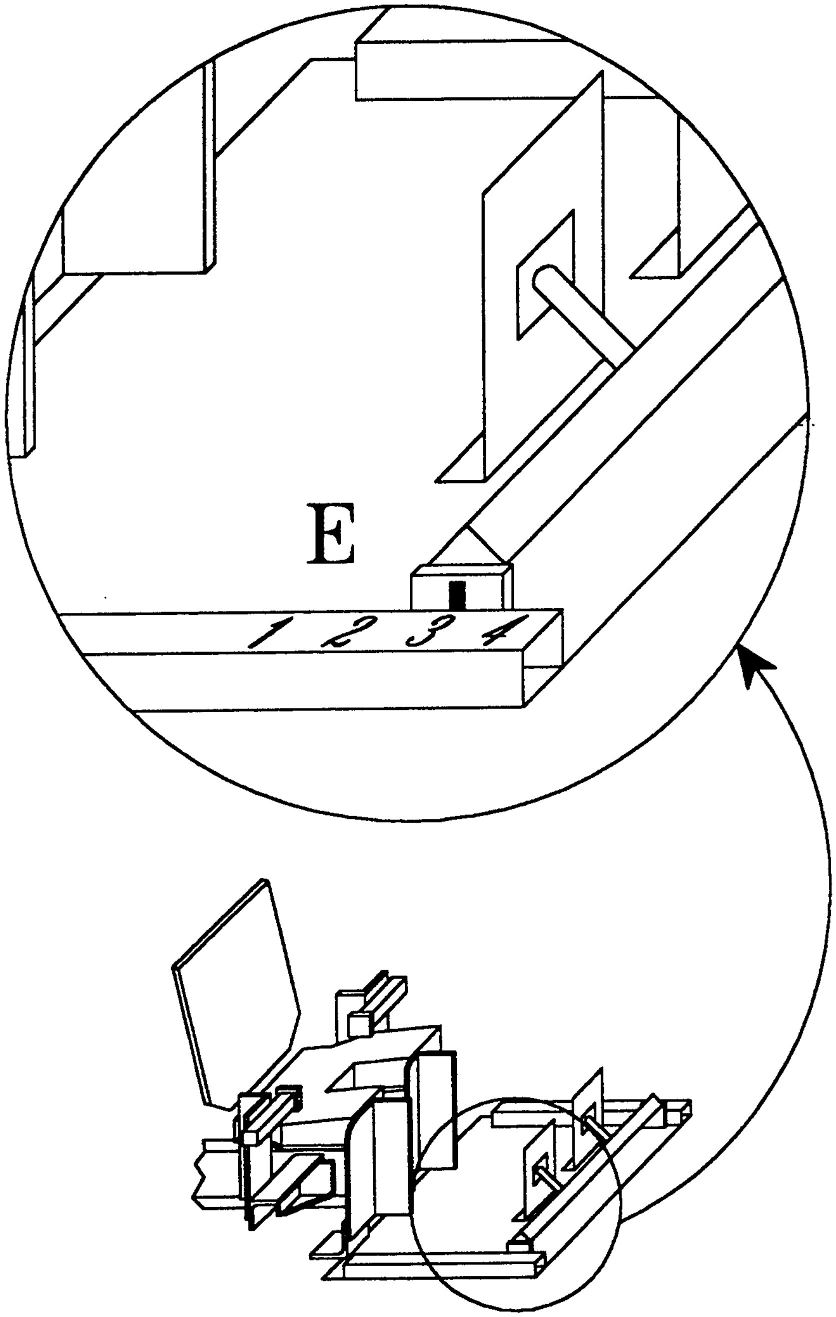
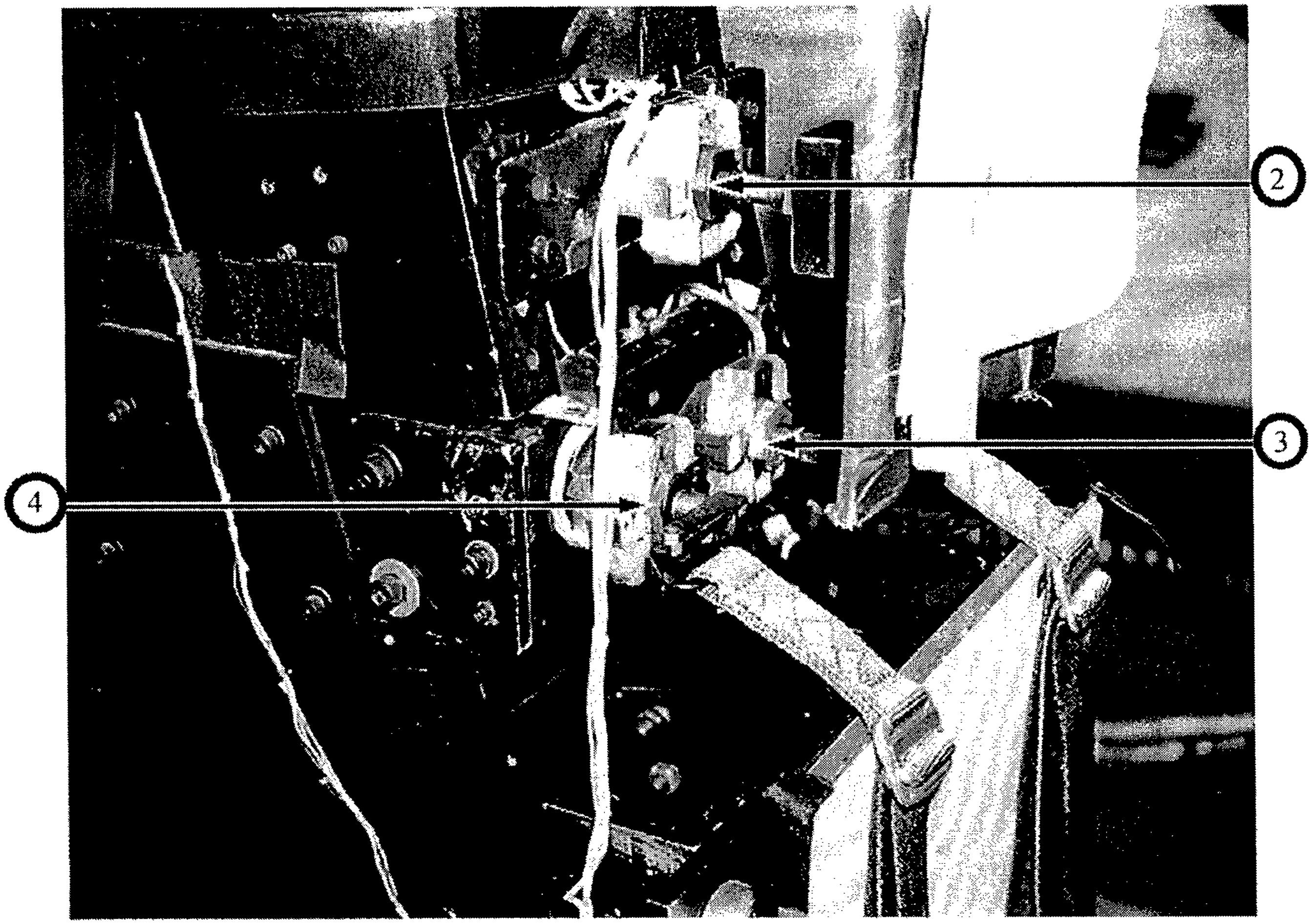


FIGURE A-9: FOOT LOAD CELL ADJUSTMENT BRACKET



NOTE: REFER TO FIGURE A-8a FOR A DESCRIPTION OF THE TRANSDUCER ITEM NUMBERS.

FIGURE A-10: SHOULDER/HEADREST LOAD CELL INSTRUMENTATION

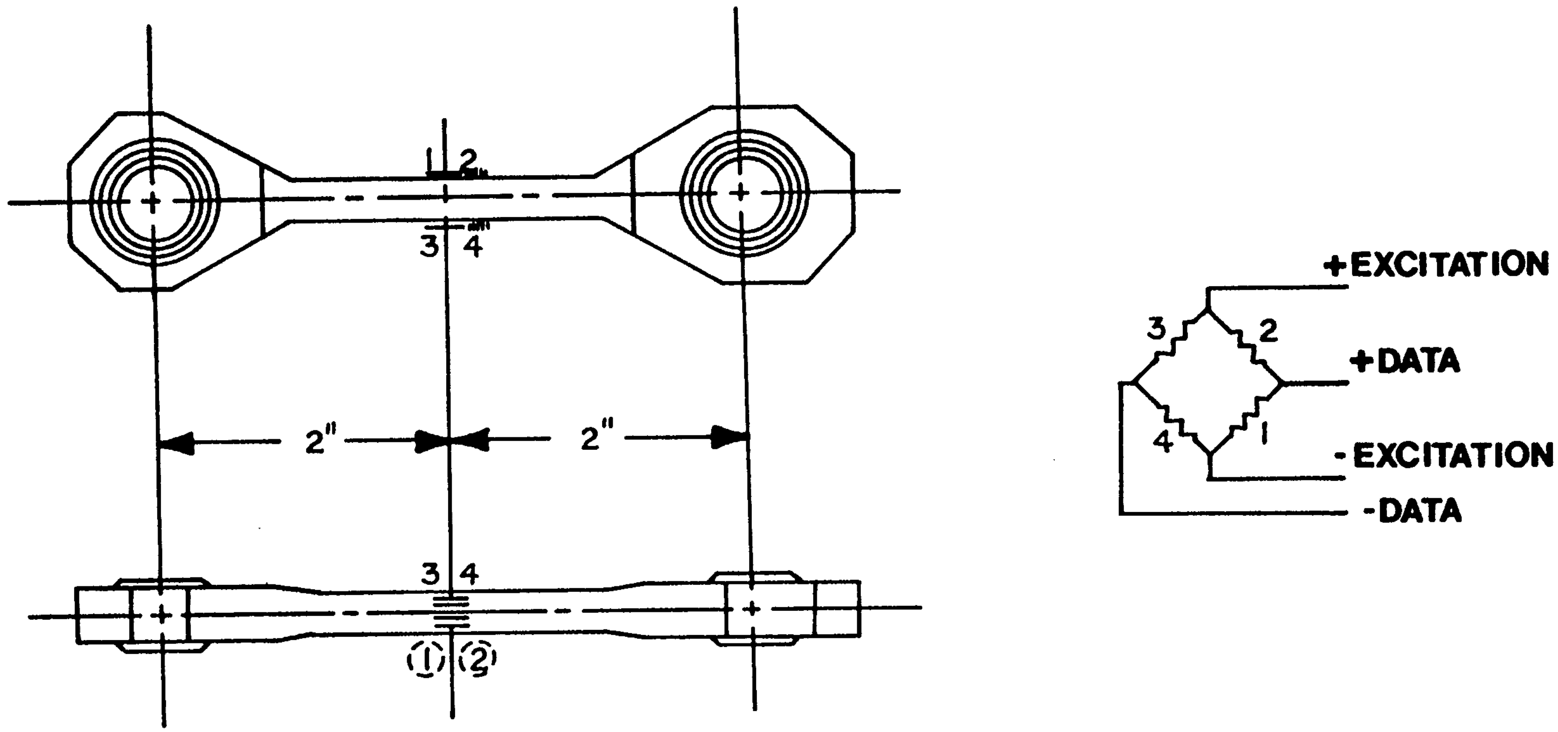
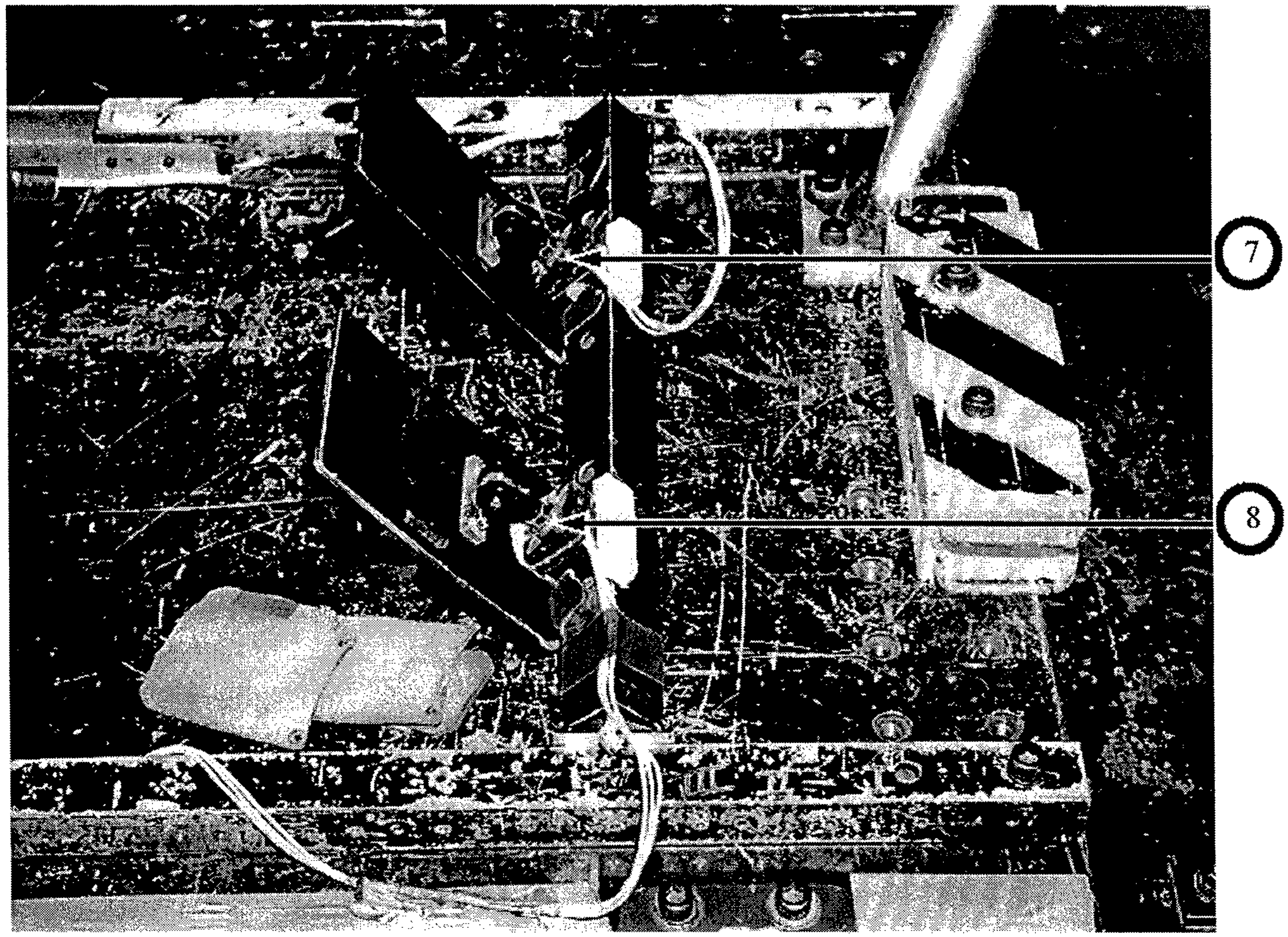


FIGURE A-11: LOAD LINK INSTRUMENTATION



NOTE: REFER TO FIGURE A-8a FOR A DESCRIPTION OF THE TRANSDUCER ITEM NUMBERS.

FIGURE A-12: FOOT LOAD CELL INSTRUMENTATION

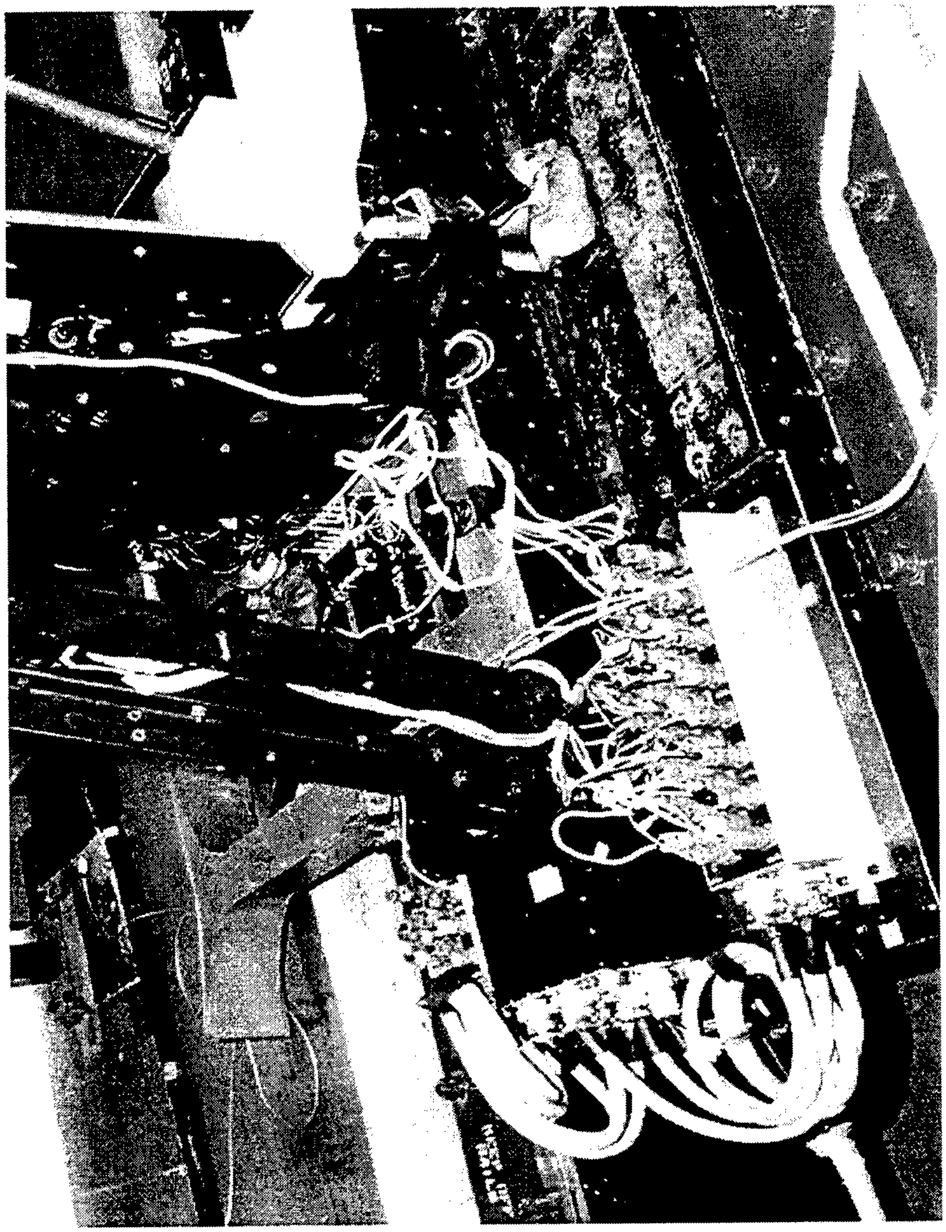


FIGURE A-13: EME DAS-64 INSTALLATION

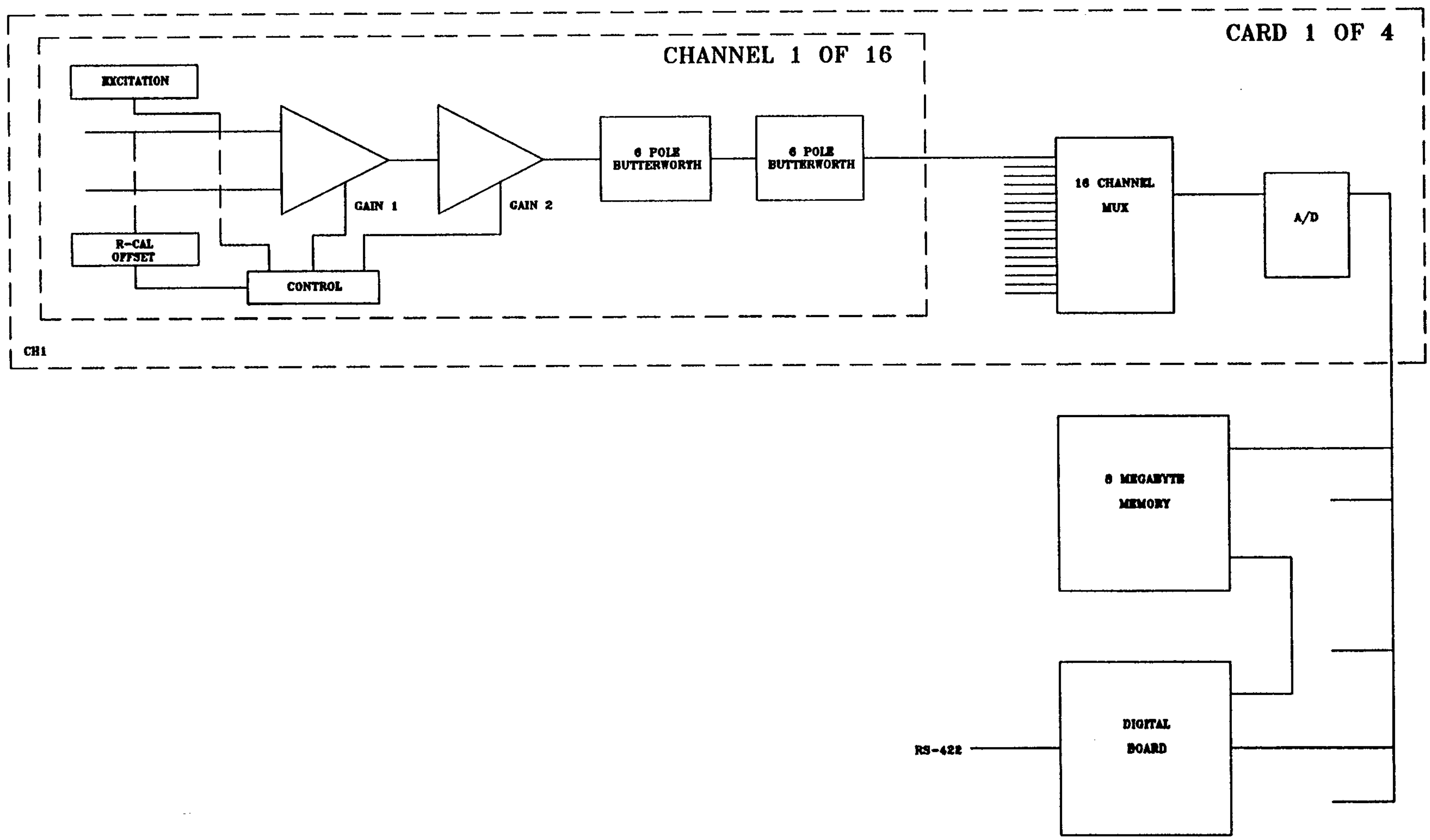


FIGURE A-14: EME DAS-64 DATA ACQUISITION SYSTEM

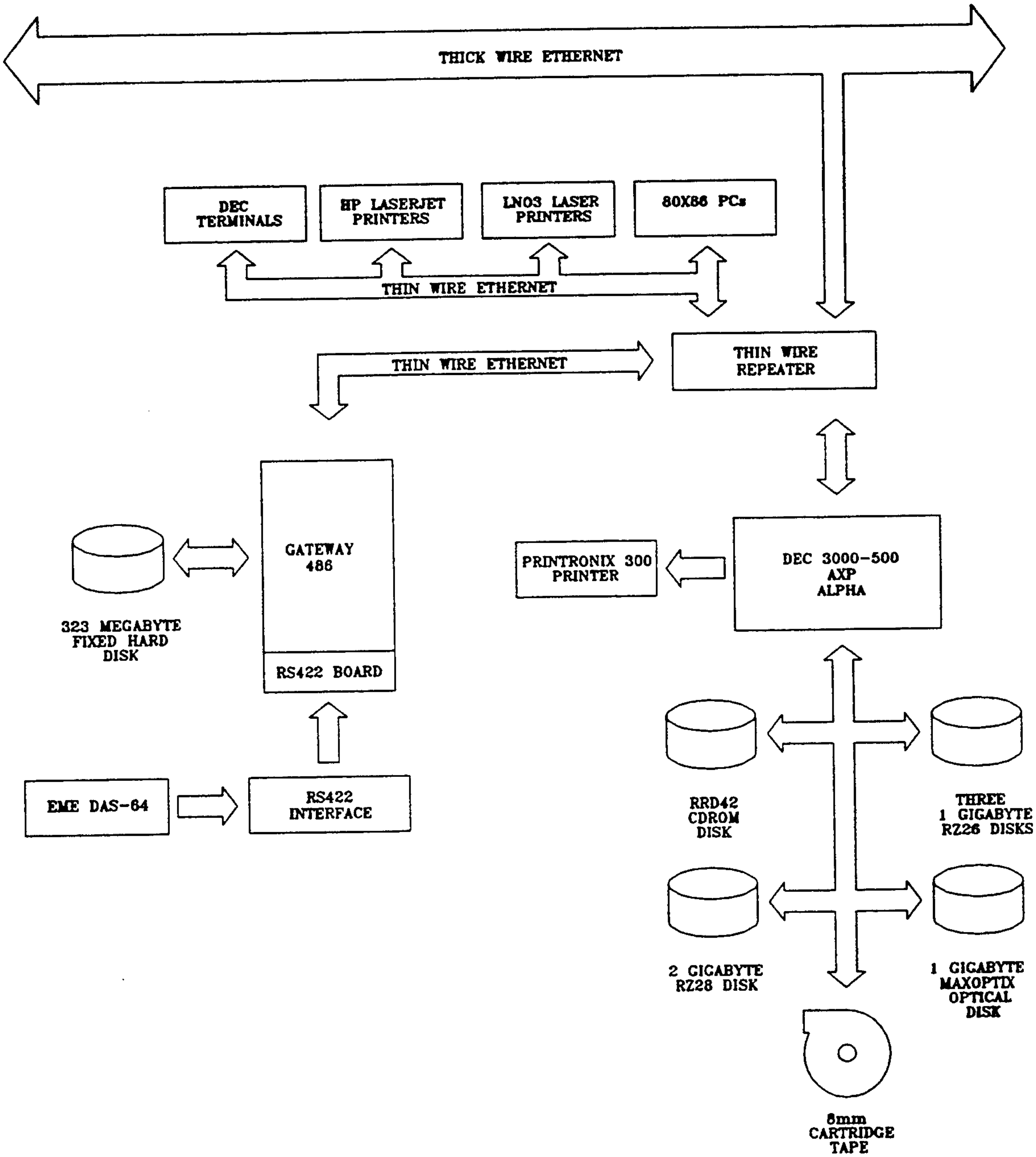


FIGURE A-15: EME DAS-64 DATA ACQUISITION AND STORAGE SYSTEM BLOCK DIAGRAM

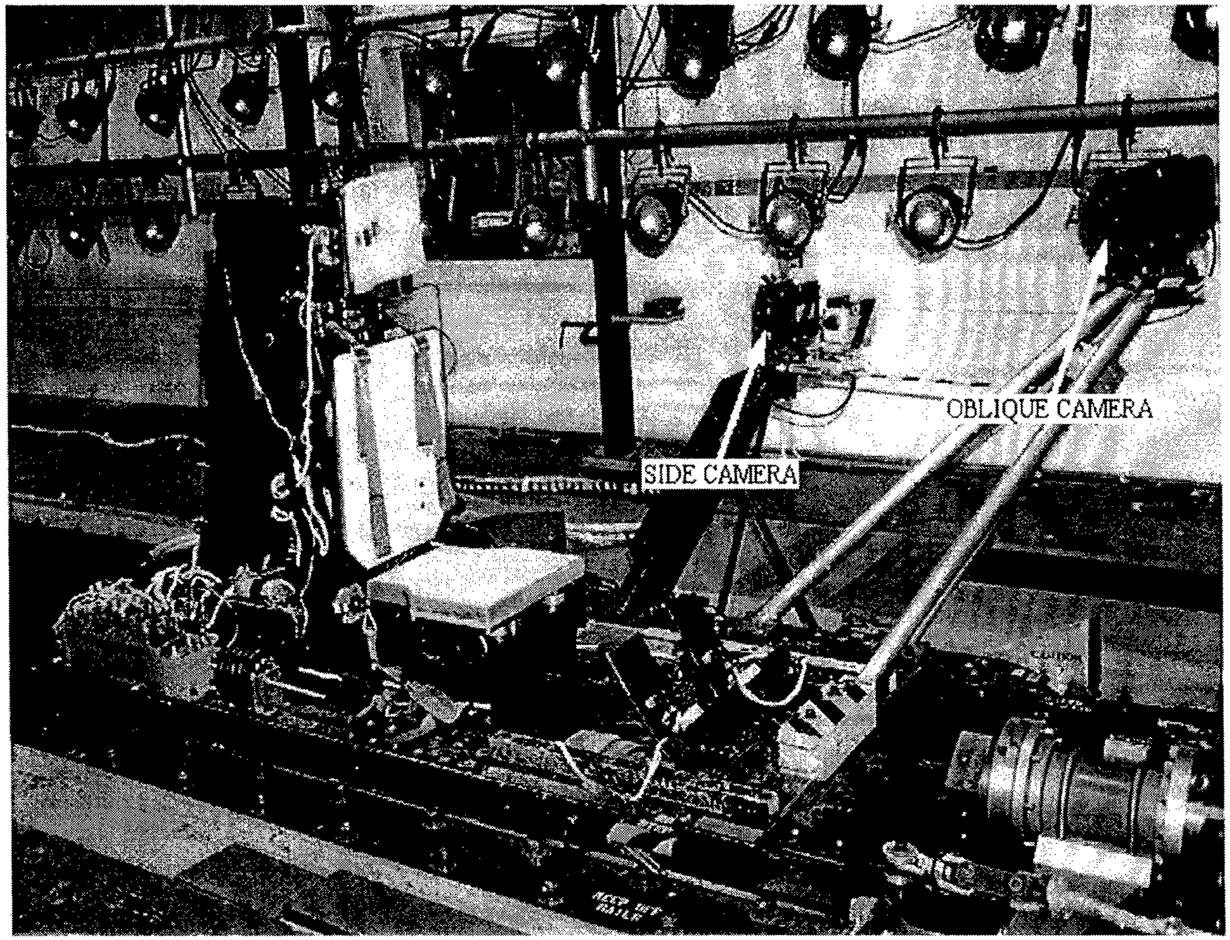


FIGURE A-16: ONBOARD SELSPOT CAMERA LOCATIONS

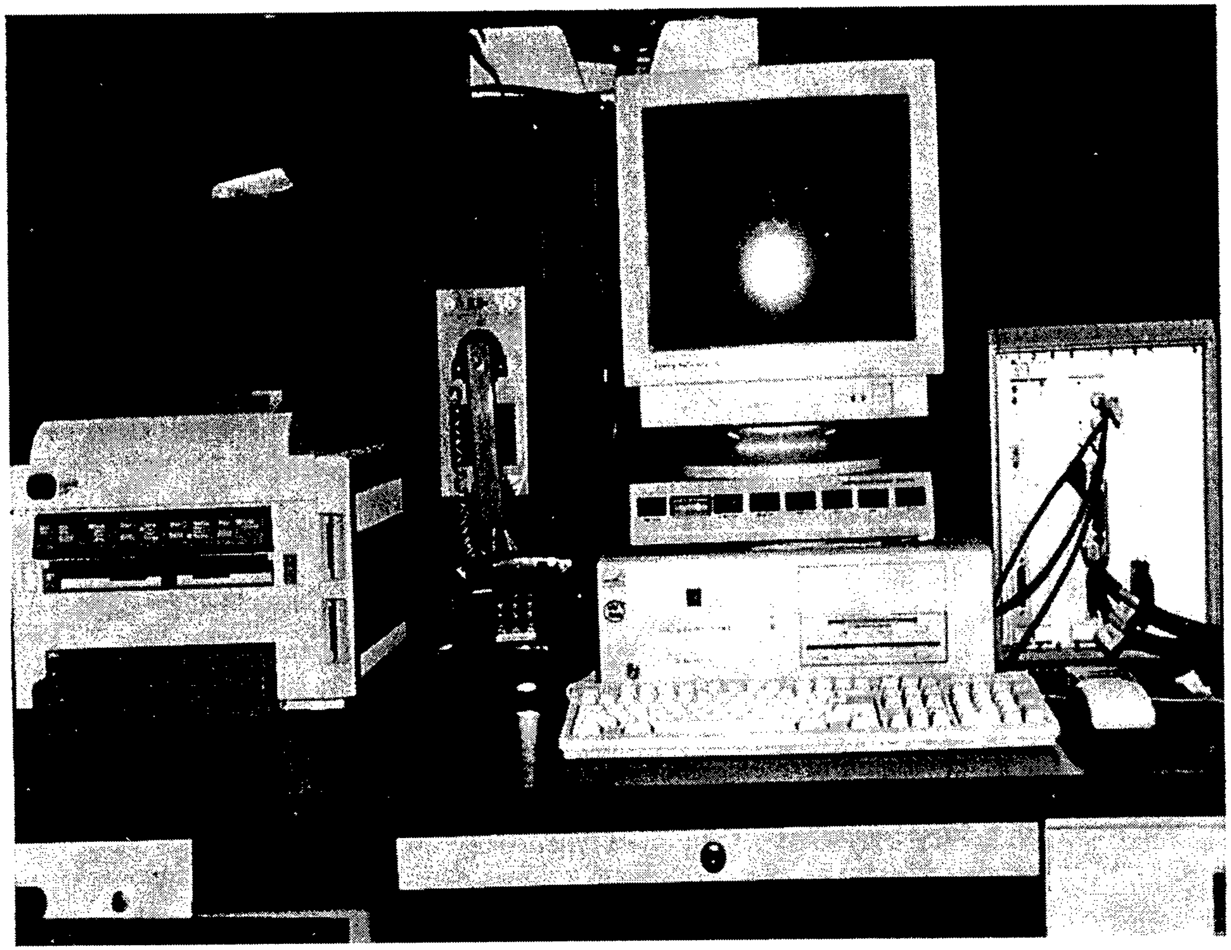
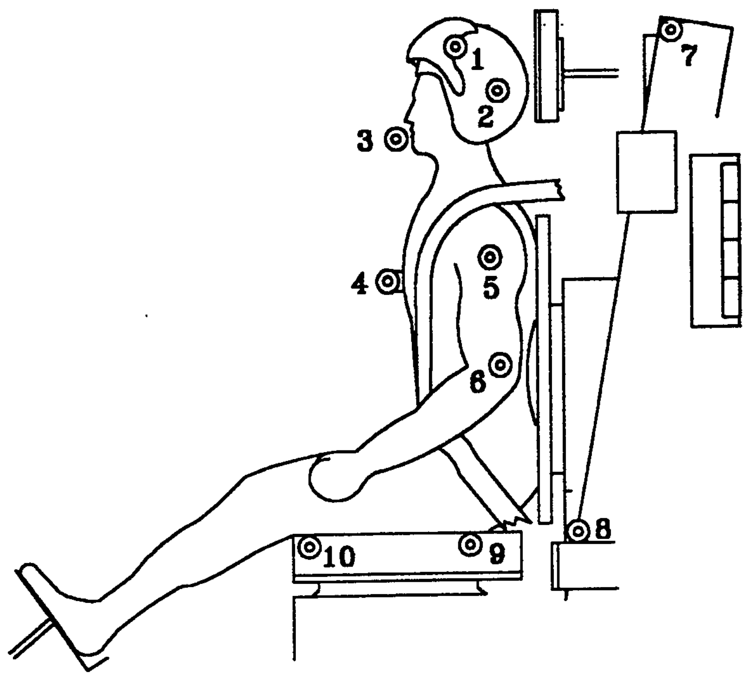


FIGURE A-17: SELSPOT COMPUTER SYSTEM



ALL DIMENSIONS ARE REFERENCED TO THE SEAT REFERENCE POINT (SRP). THE SEAT REFERENCE POINT IS LOCATED AT THE INTERSECTION OF THE SEAT PAN CENTER LINE AND THE SEAT BACK CENTER LINE (z AXIS).

	DESCRIPTION	DIMENSIONS IN MILLIMETERS		
		x	y	z
1.	HELMET TOP	-	-	-
2.	HELMET BOTTOM	-	-	-
3.	MOUTH	-	-	-
4.	CHEST	-	-	-
5.	SHOULDER	-	-	-
6.	ELBOW	-	-	-
7.	UPPER FRAME	-216.50	170.00	952.30
8.	LOWER FRAME	-229.90	197.00	110.30
9.	AFT SEAT	198.50	248.50	- 27.70
10.	FORE SEAT	449.50	249.50	- 24.20

FIGURE A-18: INFRARED TARGET (LED) LOCATIONS

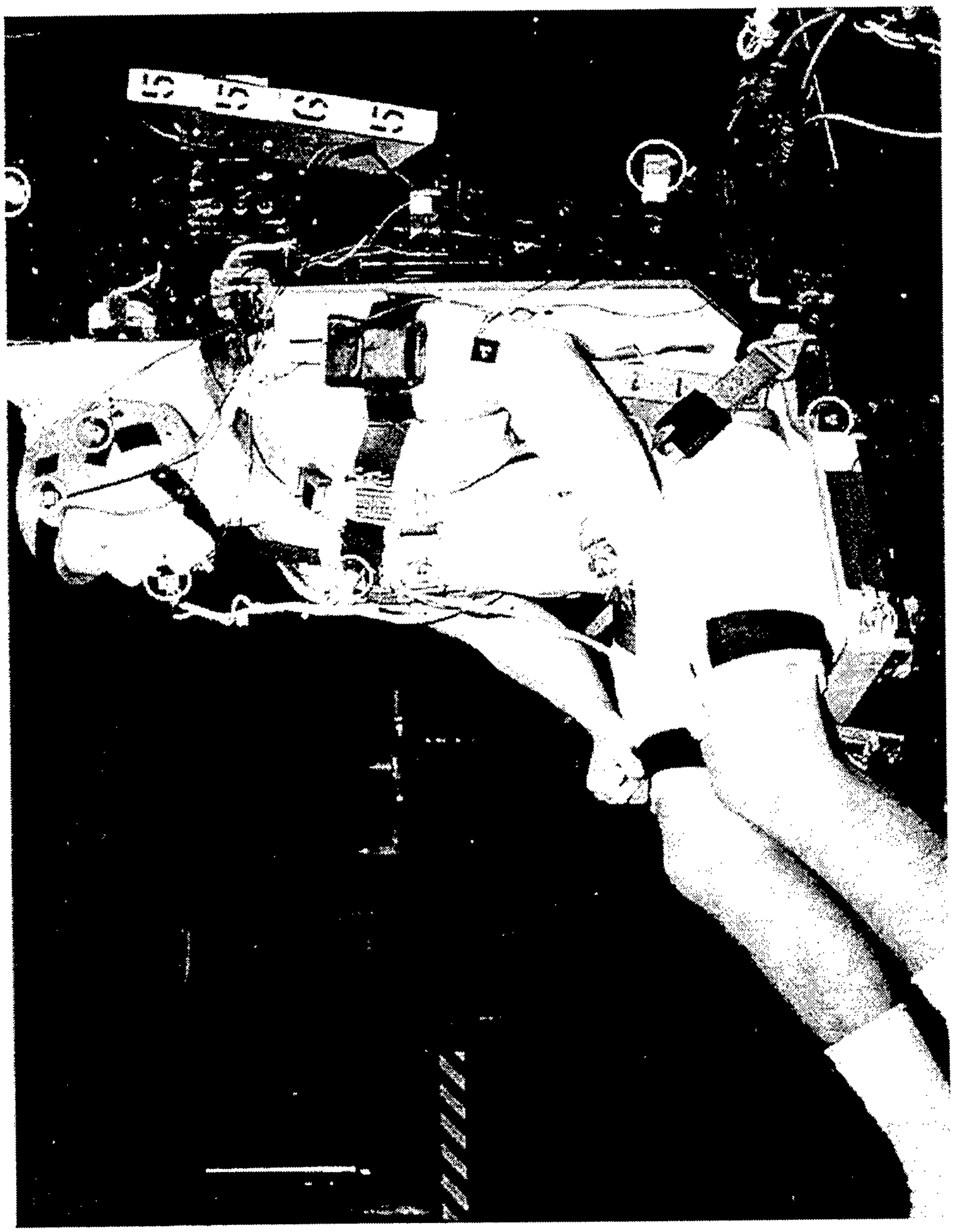


FIGURE A-19: INFRARED TARGETS

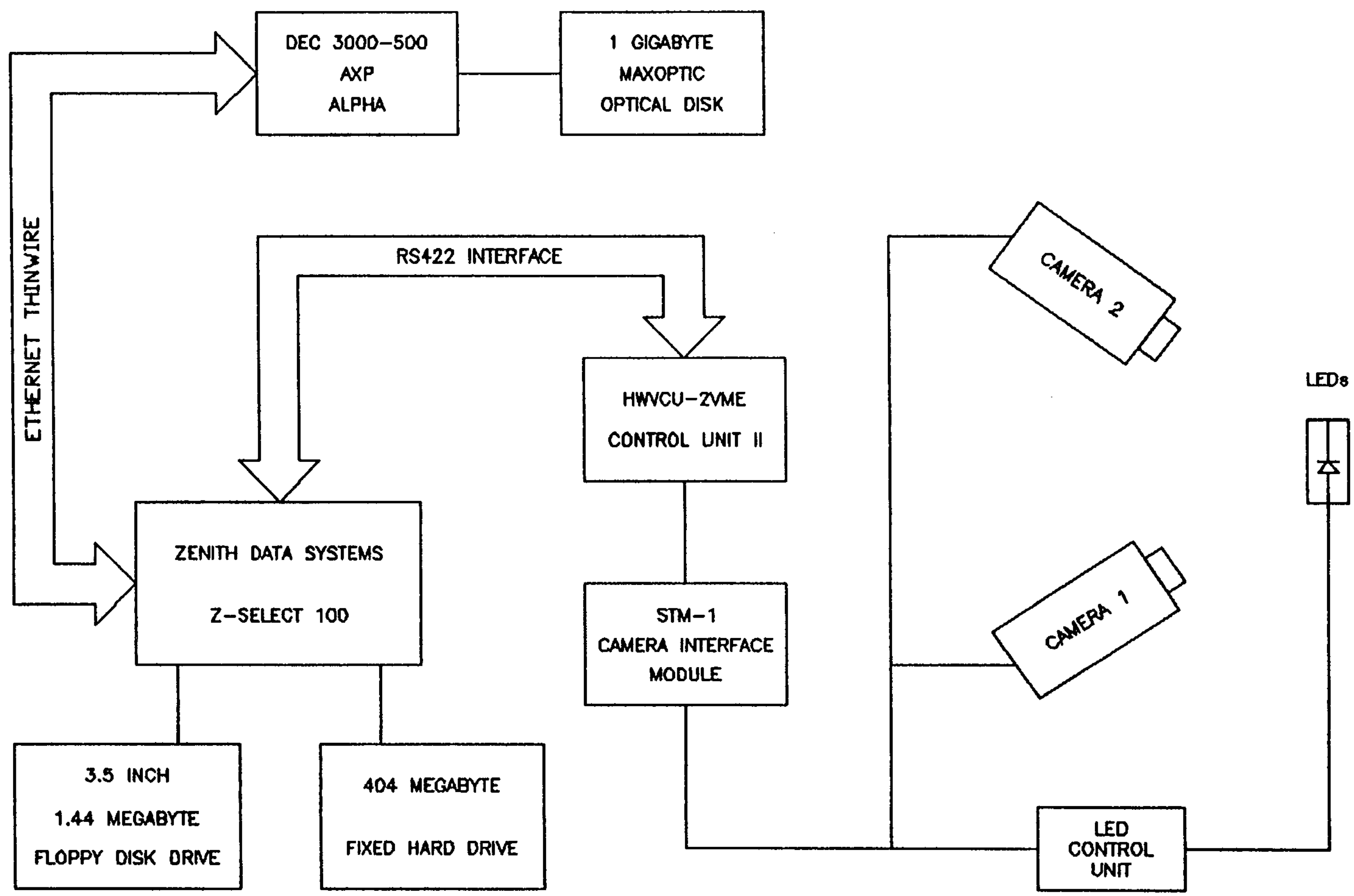


FIGURE A-20: SELSPOT MOTION ANALYSIS SYSTEM

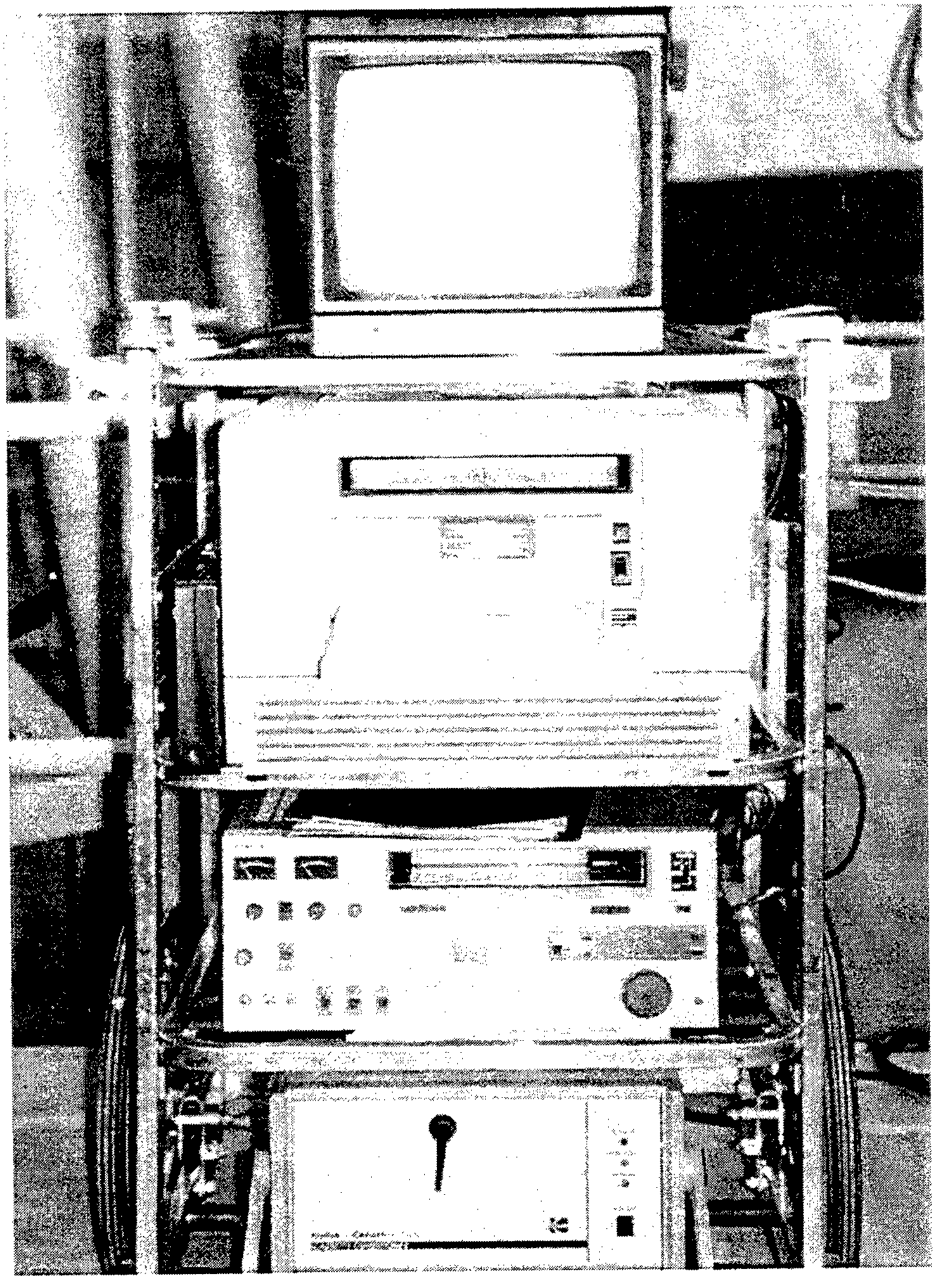


FIGURE A-21: KODAK EKTAPRO 1000 VIDEO SYSTEM

APPENDIX B

SAMPLE ACCELERATION/FORCE DATA

DRI Study Test: 5568 Test Date: 950928 Subj: R-20 Wt: 110.0
Nom G: 8.0 Cell: B 60 Hz Filter

Data ID	Immediate Preimpact	Maximum Value	Minimum Value	Time Of Maximum	Time Of Minimum
Reference Mark Time (Ms)				-79.0	
Impact Rise Time (Ms)				113.0	
Impact Duration (Ms)				205.0	
Velocity Change (Ft/Sec)		31.01			
Sled Acceleration (G)					
X Axis	0.03	8.02	-0.33	113.0	282.0
Y Axis	0.00	0.18	-0.27	91.0	101.0
Z Axis	0.99	1.10	0.34	231.0	120.0
Sled Velocity (Ft/Sec)	0.08	31.39	0.08	219.0	0.0
Seat Pan Acceleration (G)					
X Axis	-0.02	0.32	-7.86	281.0	115.0
Y Axis	0.00	0.77	-0.81	124.0	220.0
Head Acceleration (G)					
X Axis	-0.02	-0.03	-7.39	0.0	123.0
Y Axis	0.02	0.15	-0.79	340.0	128.0
Z Axis	0.99	3.85	-5.04	228.0	119.0
Resultant	0.99	8.87	0.49	120.0	341.0
Ry (Rad/Sec2)	-0.31	306.06	-261.50	120.0	232.0
Chest Acceleration (G)					
X Axis	0.02	1.97	-8.33	230.0	117.0
Y Axis	0.00	0.69	-2.73	243.0	129.0
Z Axis	1.01	4.99	0.30	112.0	206.0
Resultant	1.01	9.75	0.35	115.0	206.0
Ry (Rad/Sec2)	-2.37	231.09	-282.03	124.0	238.0
T1 Acceleration (G)					
X Axis	-0.06	0.48	-8.68	229.0	124.0
Y Axis	0.00	1.46	-0.67	143.0	199.0
Z Axis	1.00	1.22	-3.08	301.0	125.0
Resultant	1.00	9.21	0.07	124.0	212.0
T1 Corrected Acceleration (G)					
X Axis	-0.05	0.30	-9.56	229.0	125.0
Z Axis	1.02	3.59	-0.96	94.0	190.0
Resultant	1.03	9.70	0.45	124.0	211.0

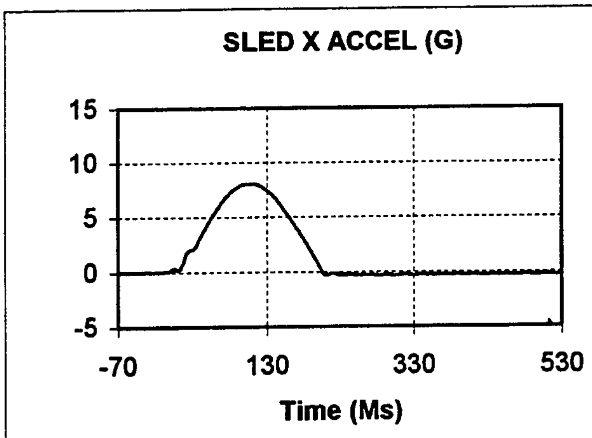
DRI Study Test: 5568 Test Date: 950928 Subj: R-20 Wt: 110.0
Nom G: 8.0 Cell: B 60 Hz Filter

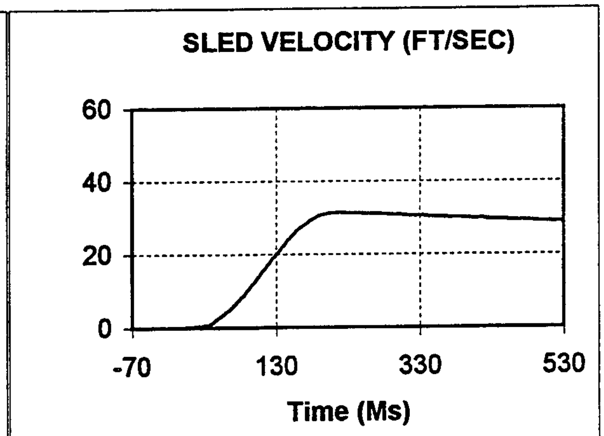
Data ID	Immediate Preimpact	Maximum Value	Minimum Value	Time Of Maximum	Time Of Minimum
Headrest Force (Lb)					
X Axis	45.65	45.92	-53.17	0.0	110.0
X Axis Minus Tare	45.78	46.83	-14.08	1.0	110.0
Y Axis	-0.34	10.34	-7.23	215.0	102.0
Z Axis	3.08	9.32	-3.39	205.0	213.0
Resultant	45.75	53.53	3.56	110.0	201.0
Resultant Minus Tare	45.89	46.94	1.32	1.0	194.0
Left Shoulder Force (Lb)					
X Axis	-75.89	-46.20	-202.78	521.0	111.0
Y Axis	13.62	34.36	8.78	114.0	514.0
Z Axis	25.59	55.11	11.70	110.0	484.0
Resultant	81.23	212.83	48.61	111.0	521.0
Right Shoulder Force (Lb)					
X Axis	-66.52	-37.23	-180.34	511.0	111.0
Y Axis	-8.89	-6.71	-27.81	214.0	134.0
Z Axis	26.18	59.70	12.35	111.0	514.0
Resultant	72.03	191.75	40.07	111.0	511.0
Left Lap Force (Lb)					
X Axis	-34.85	-22.30	-215.69	219.0	123.0
Y Axis	37.00	104.25	27.99	119.0	217.0
Z Axis	-44.61	-32.85	-175.45	219.0	121.0
Resultant	67.63	296.85	48.98	122.0	218.0
Right Lap Force (Lb)					
X Axis	-24.43	-17.44	-193.46	220.0	125.0
Y Axis	-18.94	-14.34	-91.29	218.0	123.0
Z Axis	-19.60	-11.36	-154.24	220.0	122.0
Resultant	36.61	263.59	25.46	124.0	220.0
Left Foot Force (Lb)					
X Axis	-77.56	-79.19	-199.72	0.0	104.0
Y Axis	-3.30	0.61	-13.17	209.0	167.0
Z Axis	-26.94	-18.39	-102.27	217.0	122.0
Resultant	82.17	223.43	83.78	104.0	0.0
Right Foot Force (Lb)					
X Axis	-116.54	-91.65	-280.74	207.0	102.0
Y Axis	4.83	18.72	-4.47	103.0	212.0
Z Axis	-44.40	-12.69	-128.25	219.0	101.0
Resultant	124.80	309.20	93.51	101.0	207.0

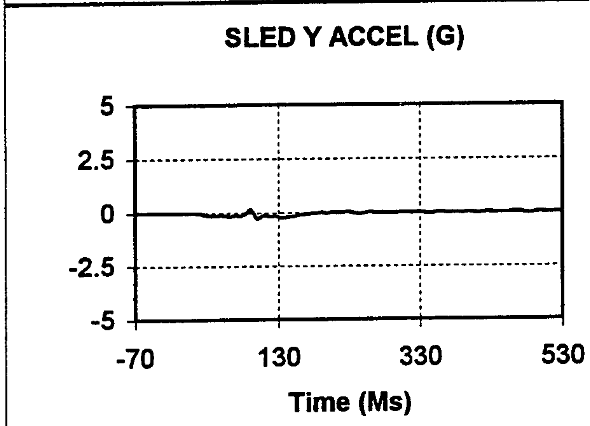
DRI Study Test: 5568 Test Date: 950928 Subj: R-20 Wt: 110.0
Nom G: 8.0 Cell: B 60 Hz Filter

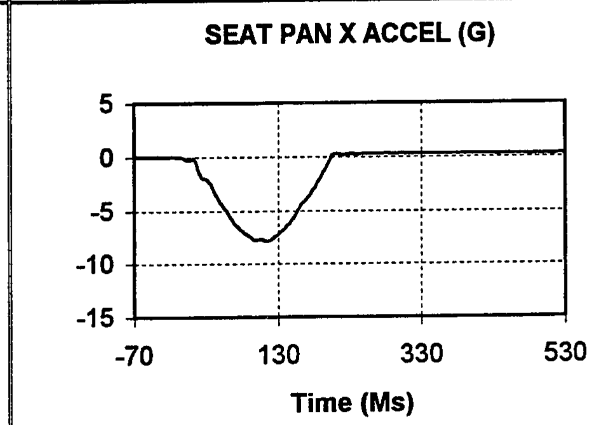
Data ID	Immediate Preimpact	Maximum Value	Minimum Value	Time Of Maximum	Time Of Minimum
Seat Back Force (Lb)					
Left X Axis	98.16	174.91	0.80	223.0	61.0
Right X Axis	114.49	193.21	4.37	223.0	66.0
Center X Axis	142.13	228.56	-0.55	199.0	111.0
X Axis Sum	354.78	545.55	7.33	223.0	64.0
X Axis Minus Tare	355.61	541.15	119.31	222.0	175.0
Top Y Axis	6.25	27.72	-28.26	120.0	107.0
Bottom Y Axis	-26.83	21.92	-88.78	163.0	106.0
Y Axis Sum	-20.58	20.50	-116.48	122.0	106.0
Z Axis	3.13	31.37	-39.89	114.0	93.0
Resultant	355.39	549.56	8.89	223.0	66.0
Resultant Minus Tare	356.22	545.40	119.66	222.0	175.0
Seat Pan Force (Lb)					
Left X Axis	25.45	44.39	-88.65	221.0	126.0
Right X Axis	3.61	24.62	-106.83	233.0	119.0
X Axis Sum	29.06	64.70	-193.73	234.0	121.0
X Axis Minus Tare	29.82	60.35	-4.79	220.0	175.0
Y Axis	15.13	18.01	-7.40	231.0	97.0
Left Z Axis	10.37	26.87	1.05	133.0	211.0
Right Z Axis	35.90	49.51	15.40	106.0	201.0
Center Z Axis	94.19	173.10	66.44	233.0	66.0
Z Axis Sum	140.46	222.91	113.49	233.0	187.0
Resultant	144.23	274.25	121.56	128.0	196.0
Resultant Minus Tare	144.39	230.54	113.86	233.0	187.0

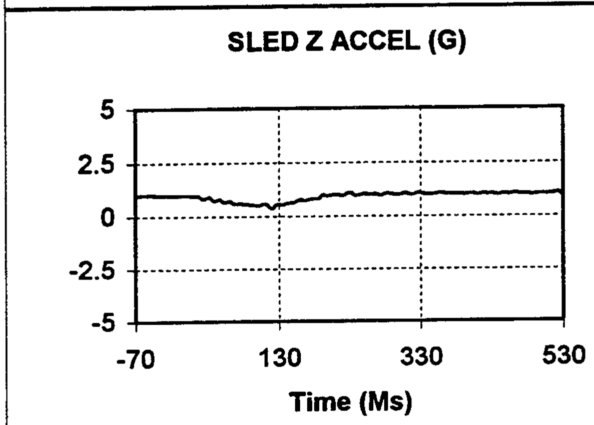
DRI Study Test: 5568 Test Date: 950928 Subj: R-20 Cell: B

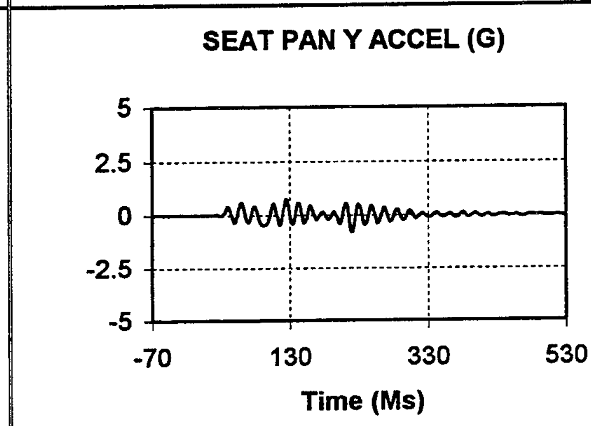












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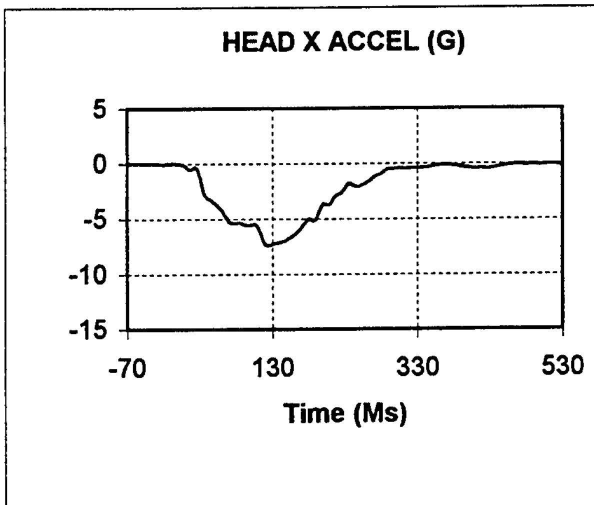
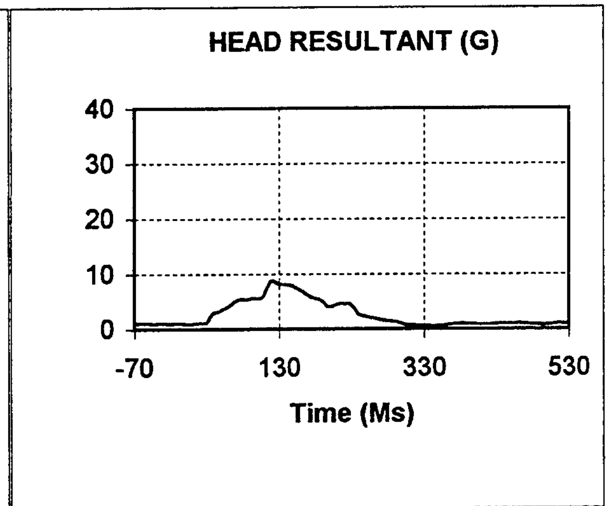
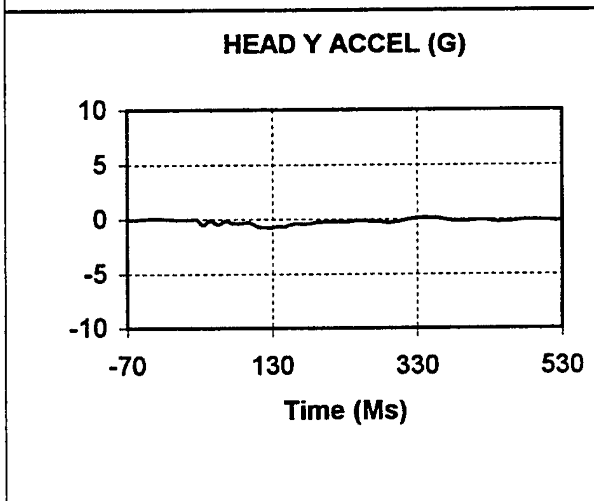
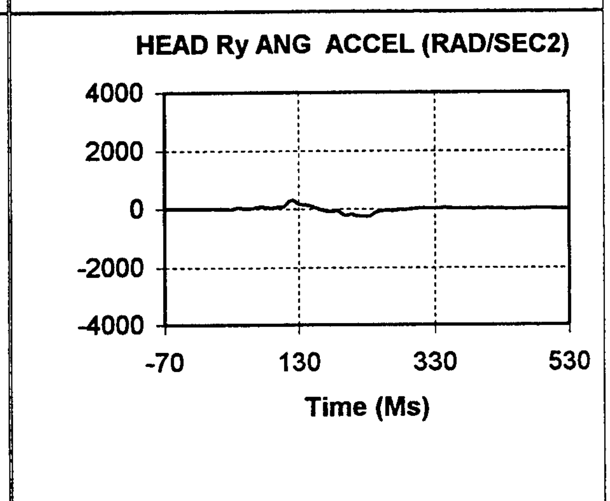
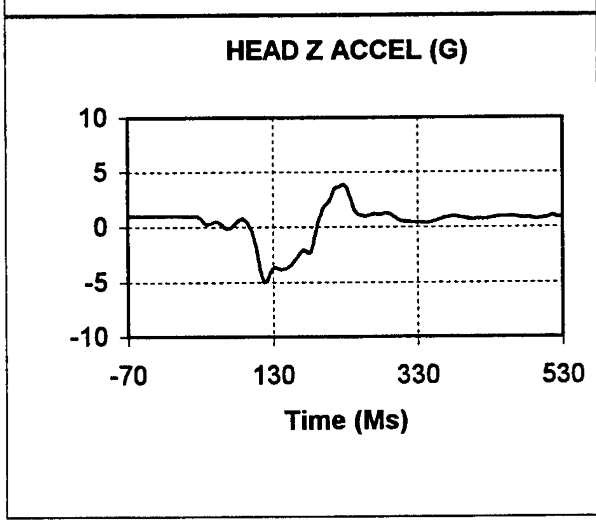
DRI Study Test: 5568 Test Date: 950928 Subj: R-20 Cell: B











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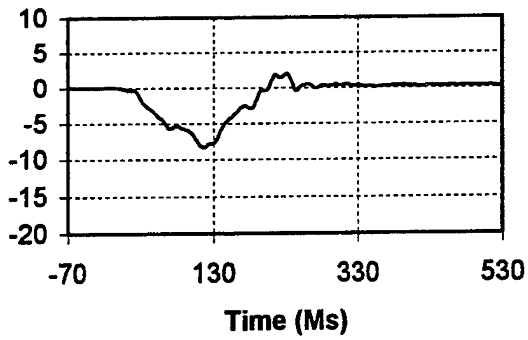
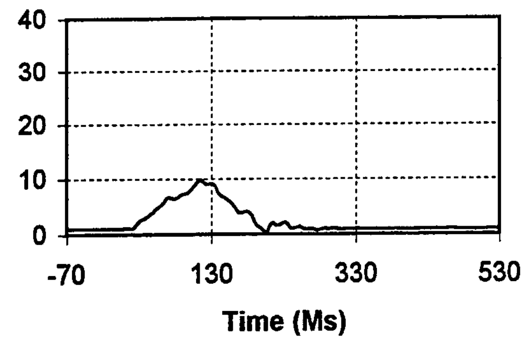
DRI Study Test: 5568 Test Date: 950928 Subj: R-20 Cell: B

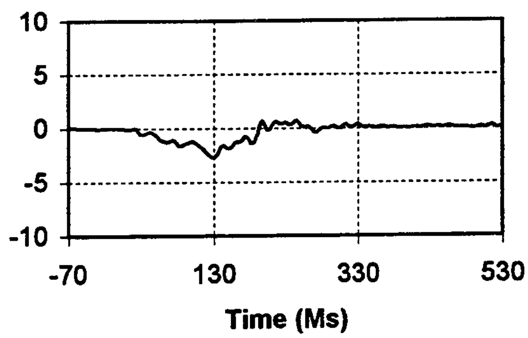
CHEST X ACCEL (G)



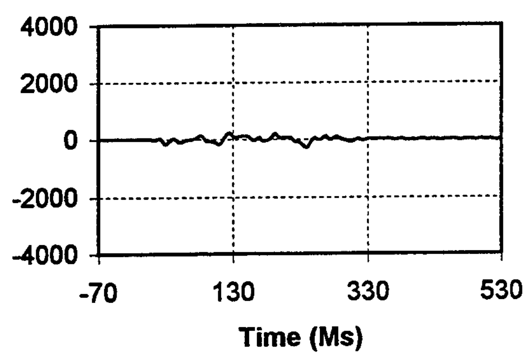
CHEST RESULTANT (G)



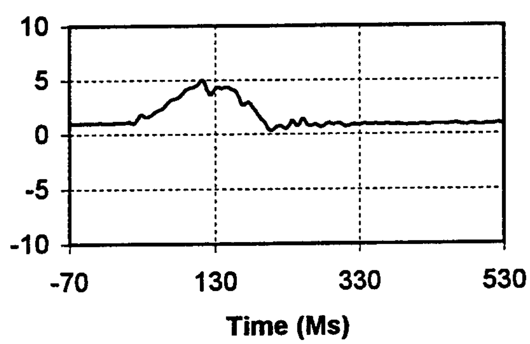
CHEST Y ACCEL (G)



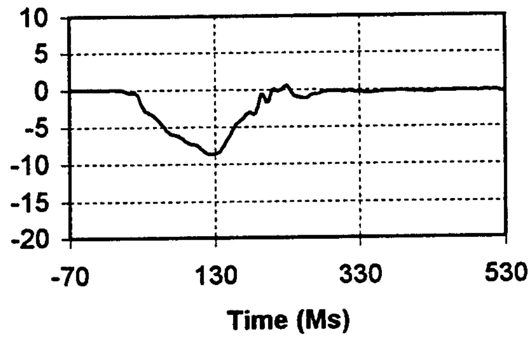
CHEST Ry ANG ACCEL (RAD/SEC2)



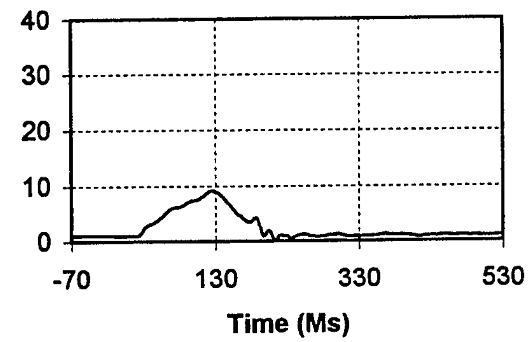
CHEST Z ACCEL (G)



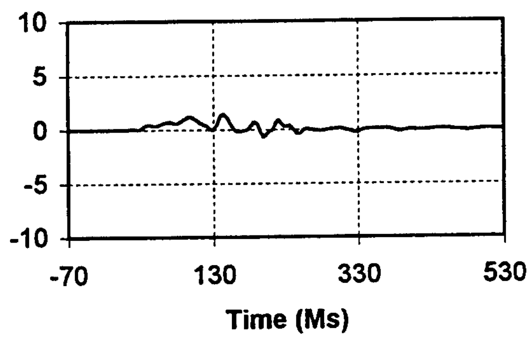
T1 X ACCEL (G)



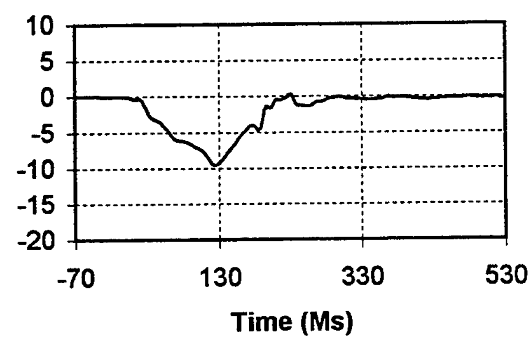
T1 RESULTANT (G)



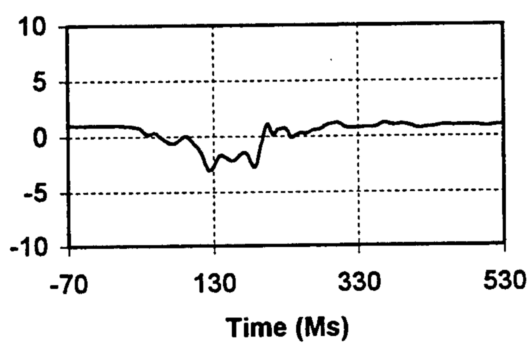
T1 Y ACCEL (G)



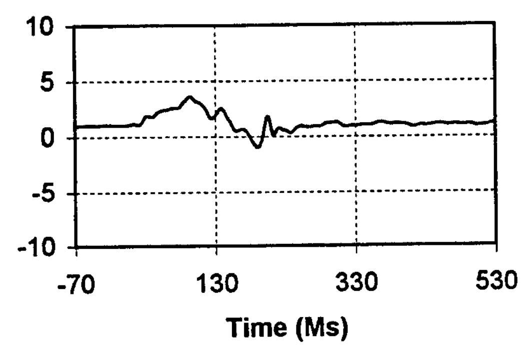
CORRECTED T1 X ACCEL (G)



T1 Z ACCEL (G)

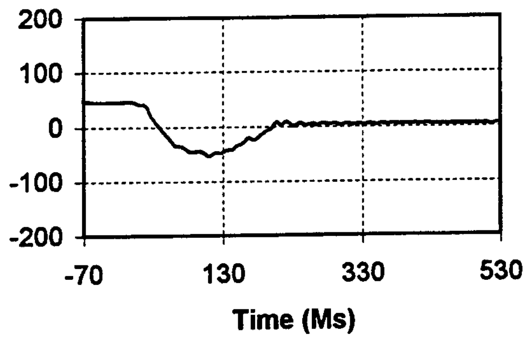


CORRECTED T1 Z ACCEL (G)

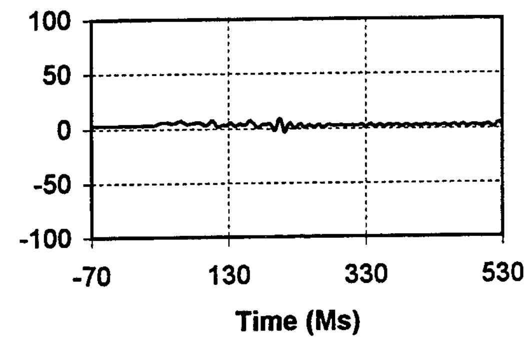


DRI Study Test: 5568 Test Date: 950928 Subj: R-20 Cell: B

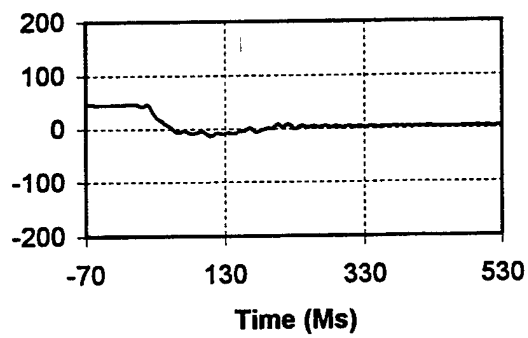
HEADREST X FORCE (LB)



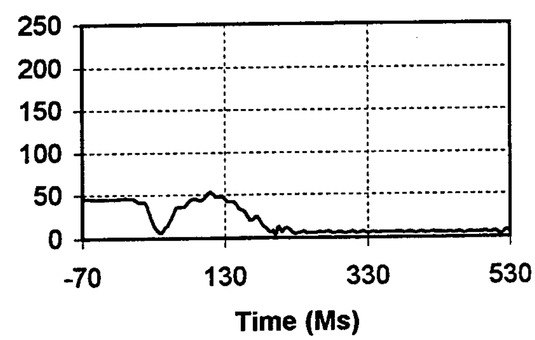
HEADREST Z FORCE (LB)



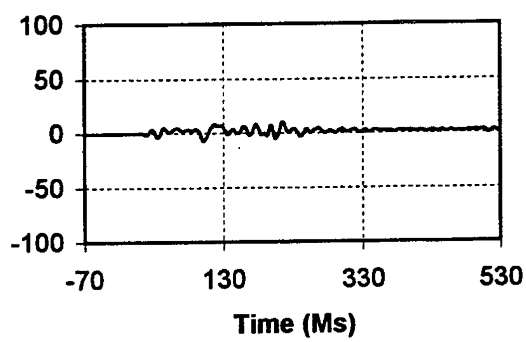
HEADREST X MINUS TARE (LB)



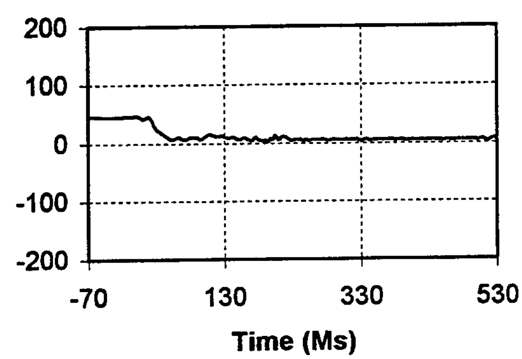
HEADREST RESULTANT (LB)



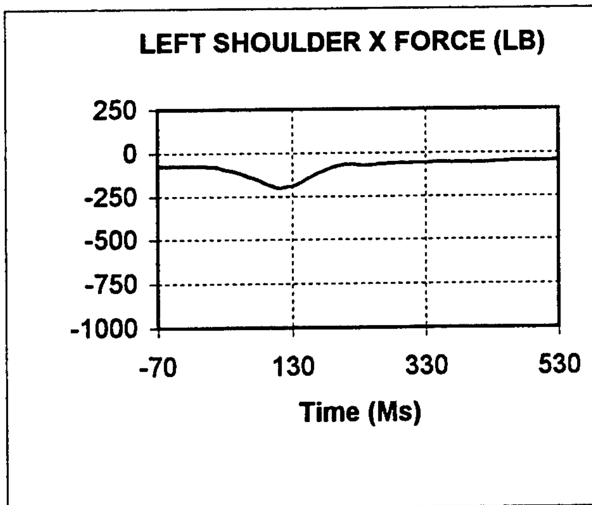
HEADREST Y FORCE (LB)

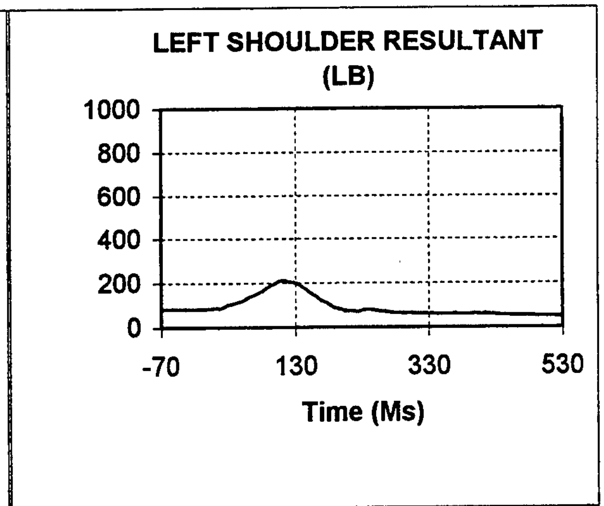


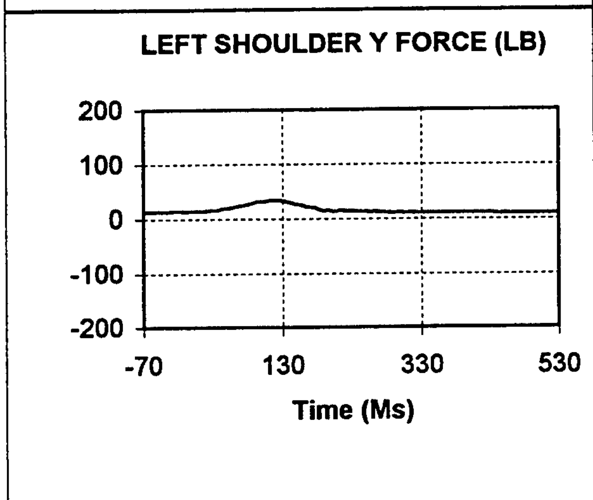
HEADREST RES MINUS TARE (LB)

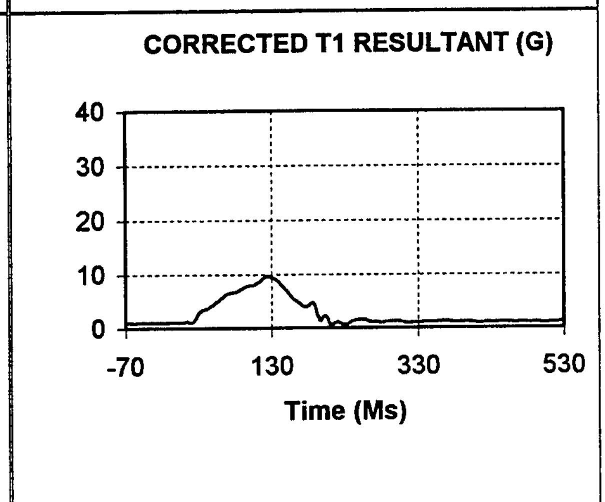


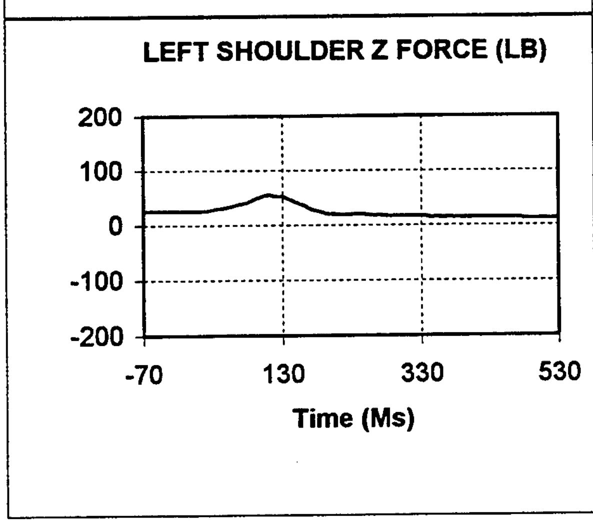
DRI Study Test: 5568 Test Date: 950928 Subj: R-20 Cell: B











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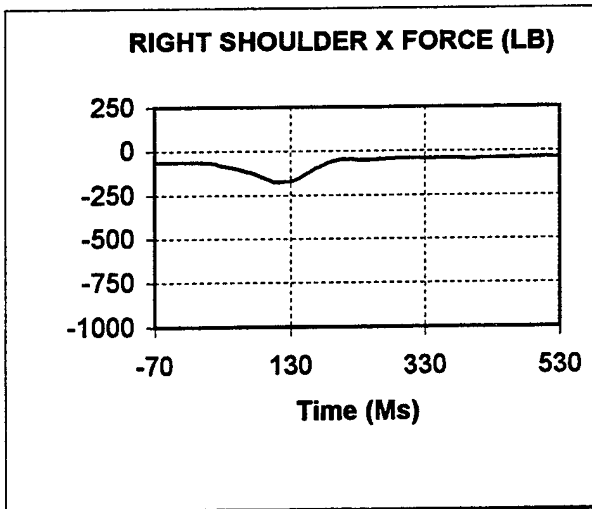
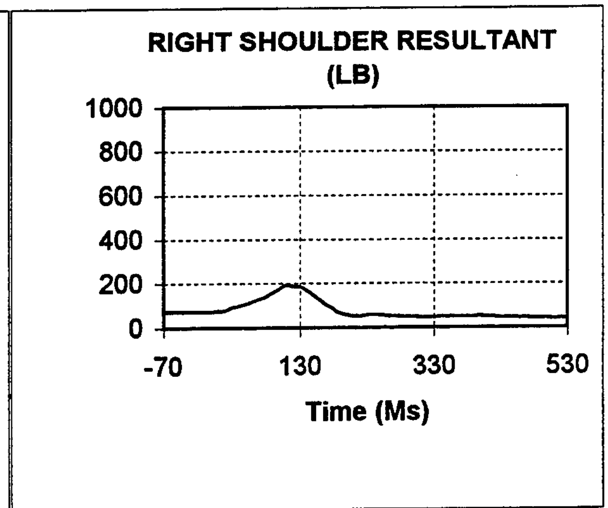
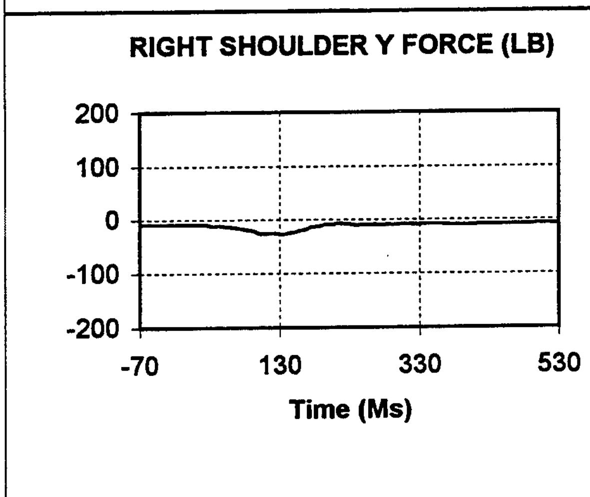
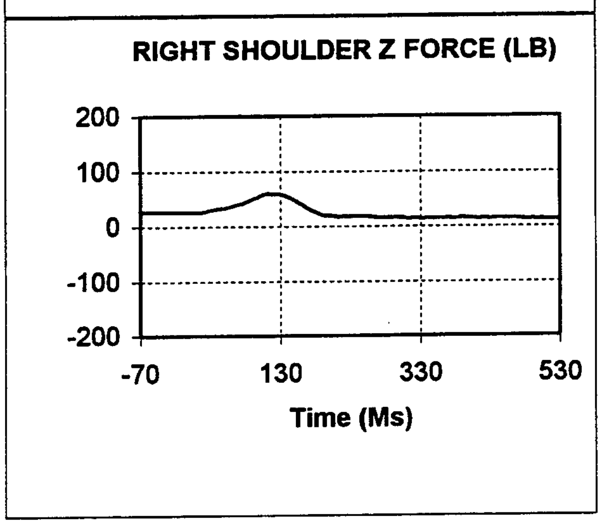
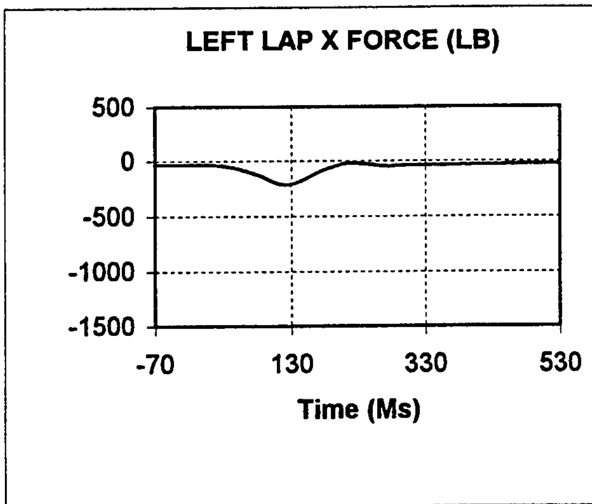

RIGHT SHOULDER X FORCE (LB)
250
0
-250
-500
-750
-1000
-70
130
330
530
Time (Ms)

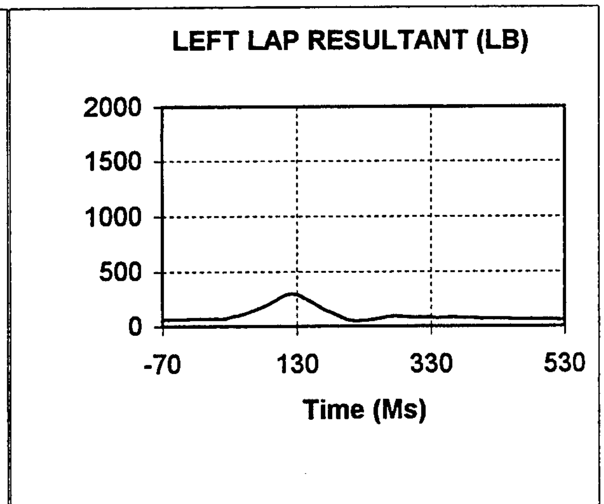

RIGHT SHOULDER RESULTANT (LB)
1000
800
600
400
200
0
-70
130
330
530
Time (Ms)

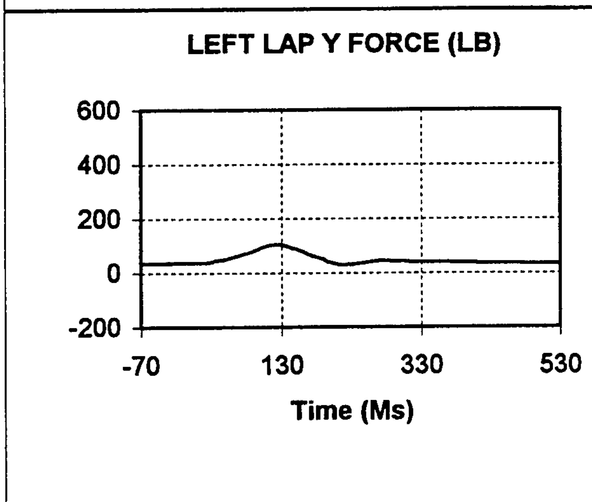

RIGHT SHOULDER Y FORCE (LB)
200
100
0
-100
-200
-70
130
330
530
Time (Ms)

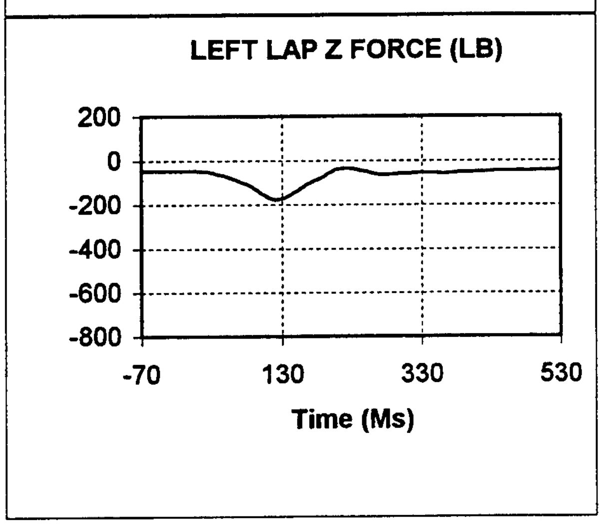

RIGHT SHOULDER Z FORCE (LB)
200
100
0
-100
-200
-70
130
330
530
Time (Ms)

DRI Study Test: 5568 Test Date: 950928 Subj: R-20 Cell: B









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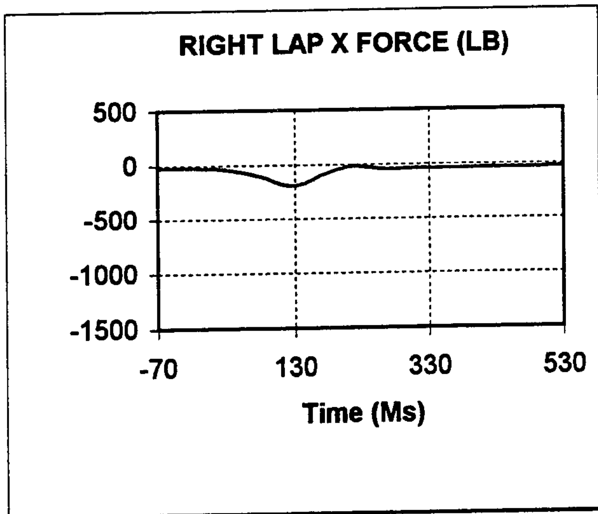
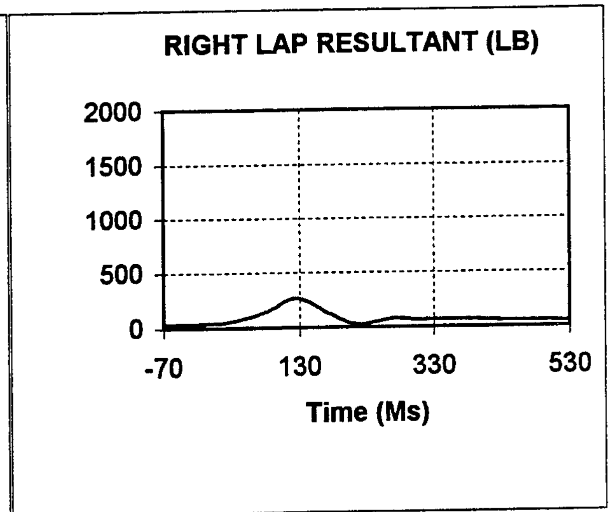
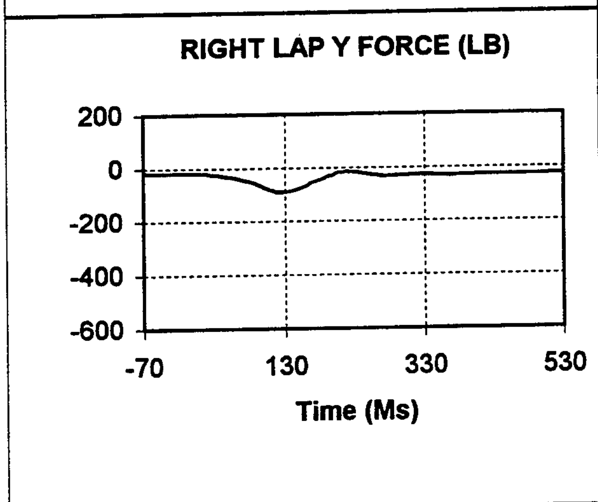
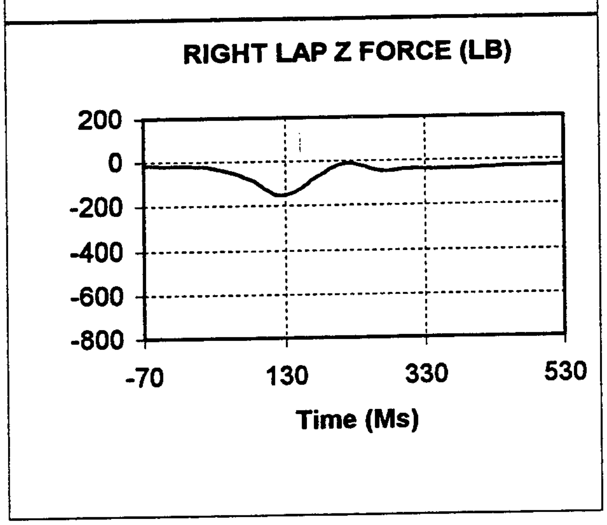
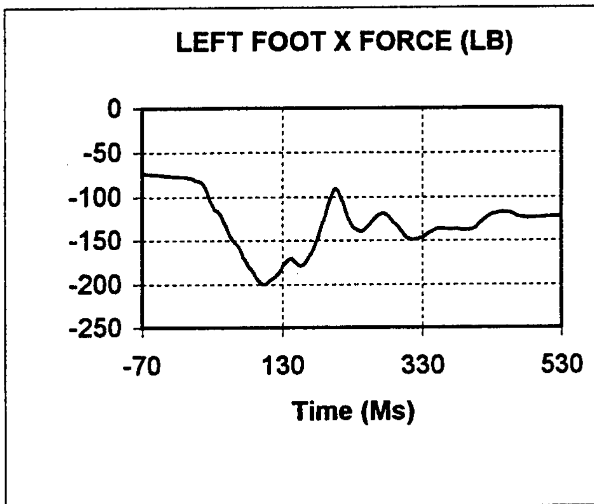

RIGHT LAP X FORCE (LB)
500
0
-500
-1000
-1500
-70
130
330
530
Time (Ms)

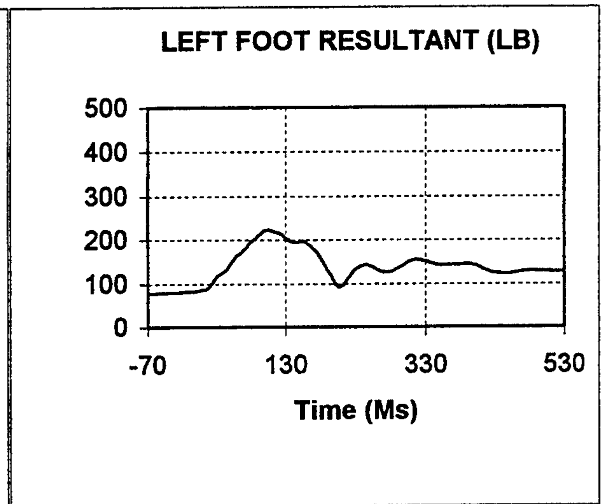

RIGHT LAP RESULTANT (LB)
2000
1500
1000
500
0
-70
130
330
530
Time (Ms)

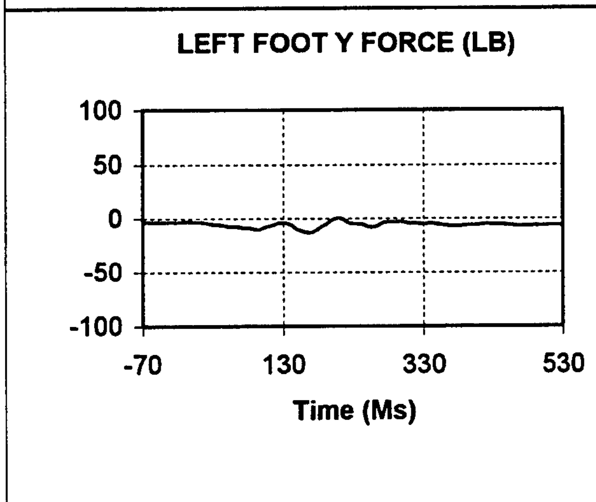

RIGHT LAP Y FORCE (LB)
200
0
-200
-400
-600
-70
130
330
530
Time (Ms)

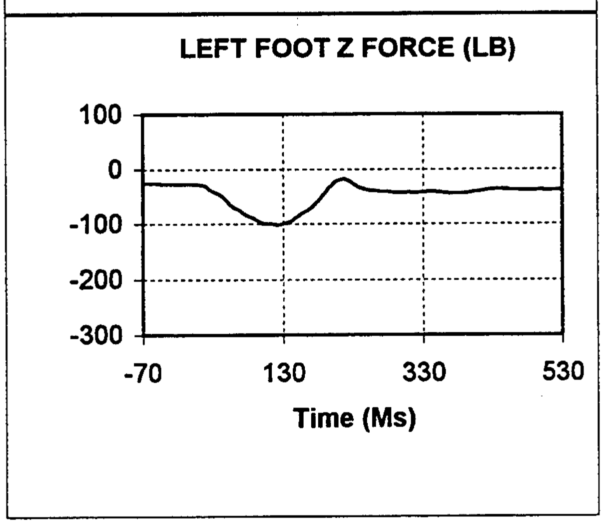

RIGHT LAP Z FORCE (LB)
200
0
-200
-400
-600
-800
-70
130
330
530
Time (Ms)

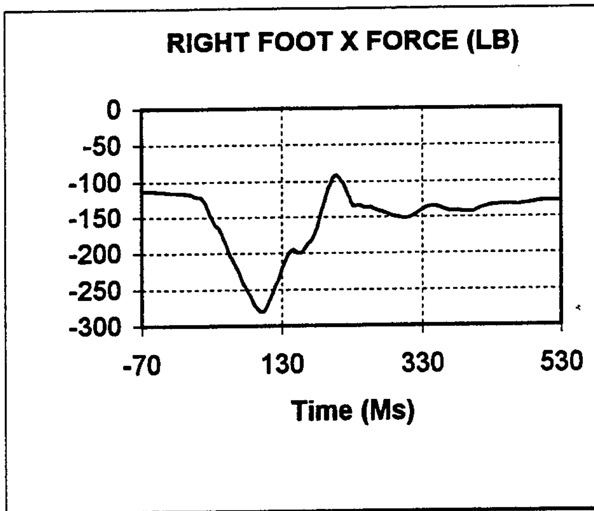
DRI Study Test: 5568 Test Date: 950928 Subj: R-20 Cell: B

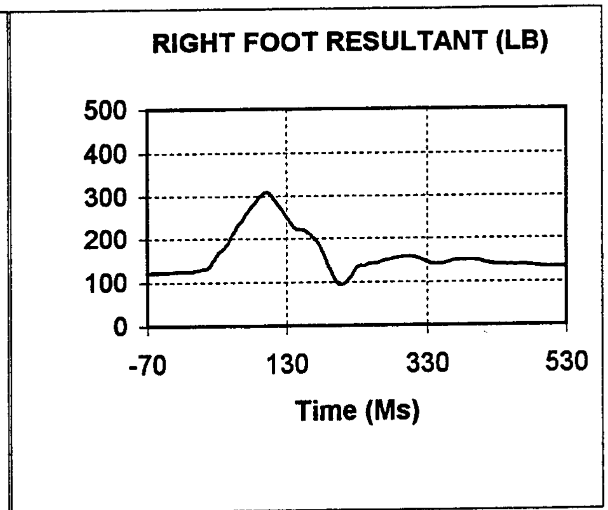


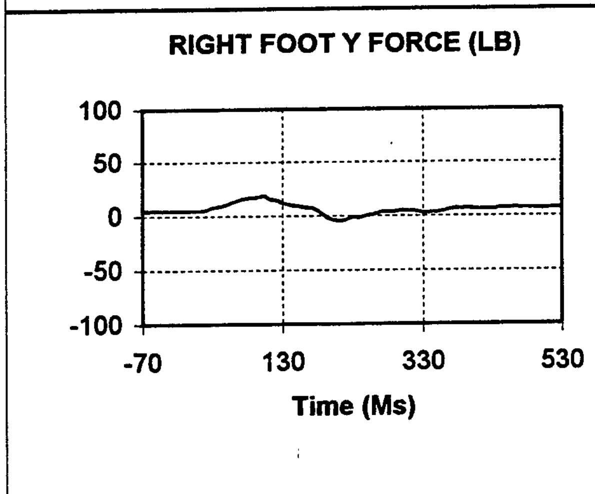


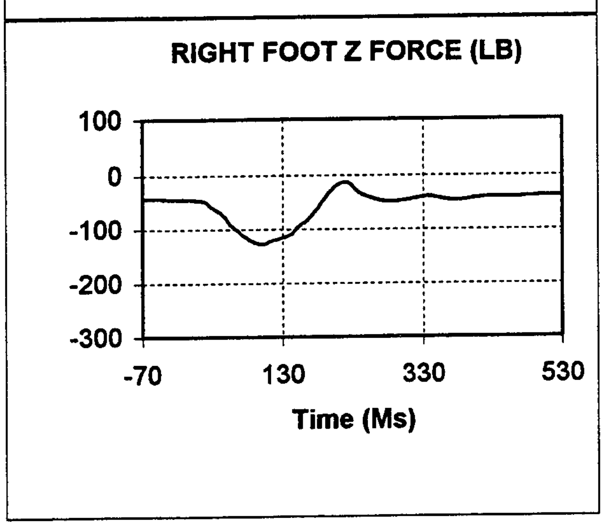




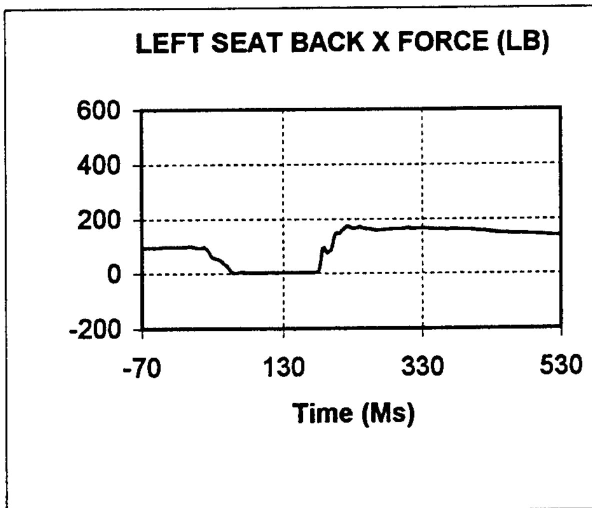

RIGHT FOOT X FORCE (LB)
0
-50
-100
-150
-200
-250
-300
-70
130
330
530
Time (Ms)

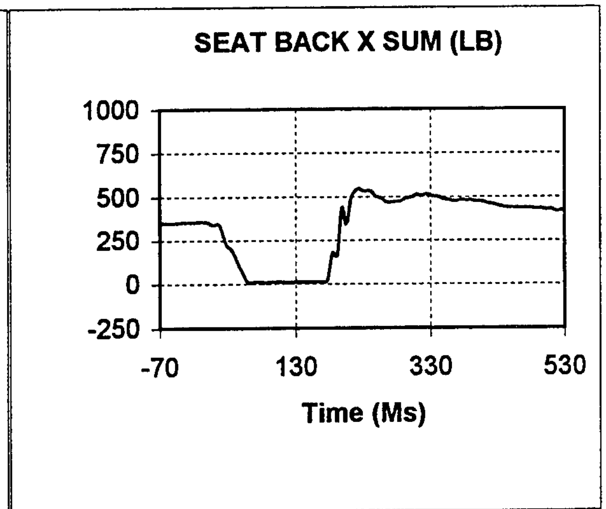

RIGHT FOOT RESULTANT (LB)
500
400
300
200
100
0
-70
130
330
530
Time (Ms)

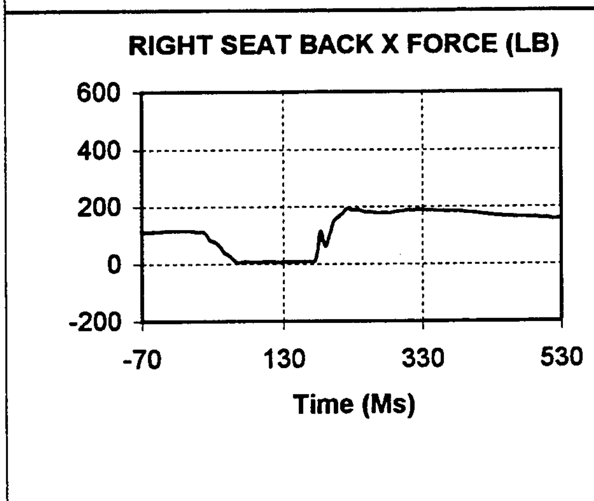

RIGHT FOOT Y FORCE (LB)
100
50
0
-50
-100
-70
130
330
530
Time (Ms)

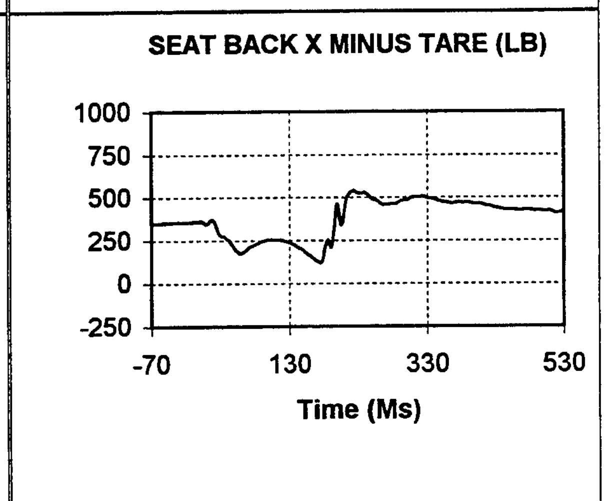

RIGHT FOOT Z FORCE (LB)
100
0
-100
-200
-300
-70
130
330
530
Time (Ms)

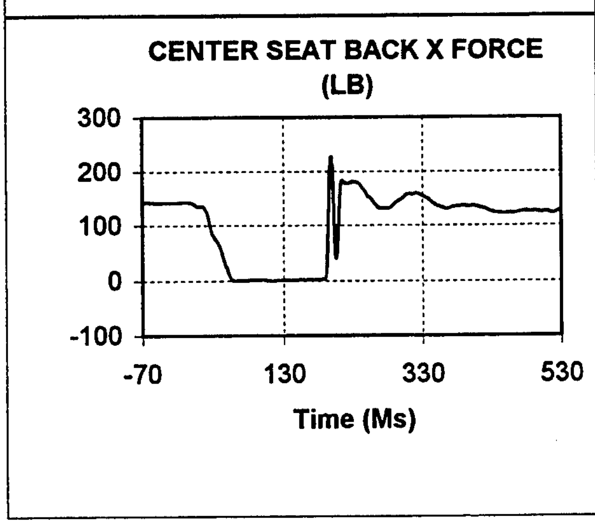
DRI Study Test: 5568 Test Date: 950928 Subj: R-20 Cell: B











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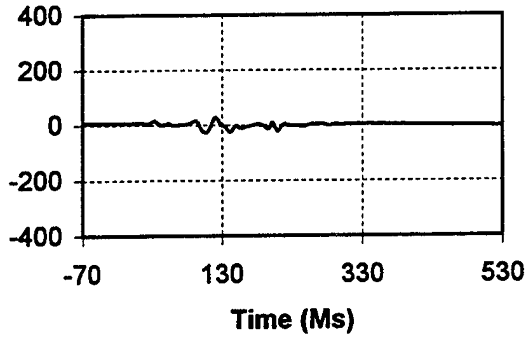
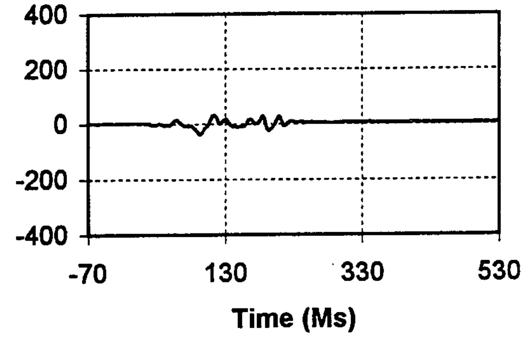
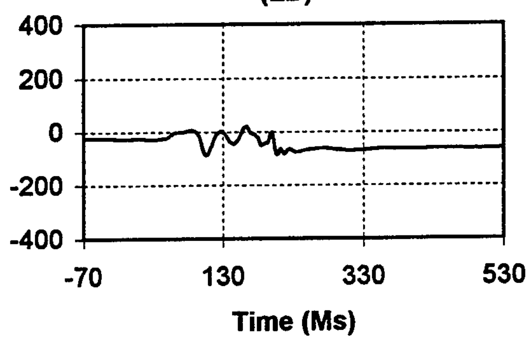
TOP SEAT BACK Y FORCE (LB)



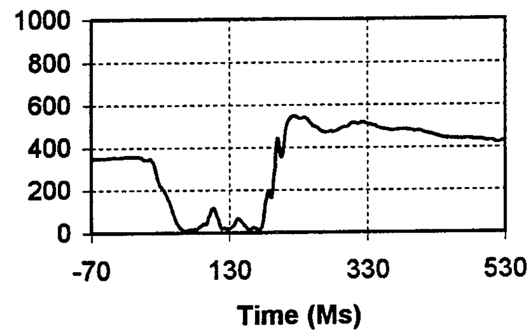
SEAT BACK Z FORCE (LB)



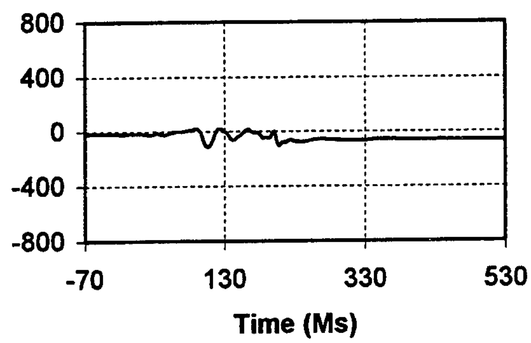
BOTTOM SEAT BACK Y FORCE (LB)



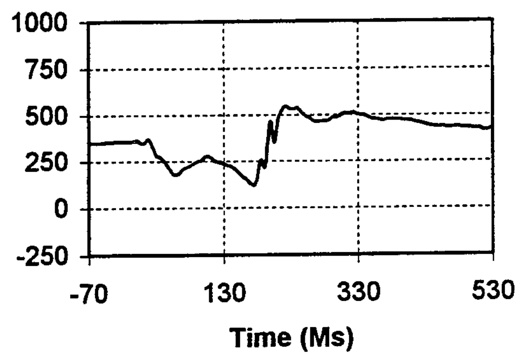
SEAT BACK RESULTANT (LB)



SEAT BACK Y SUM (LB)

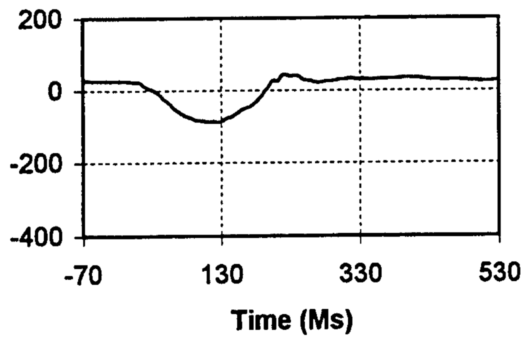


SEAT BACK RES MINUS TARE (LB)

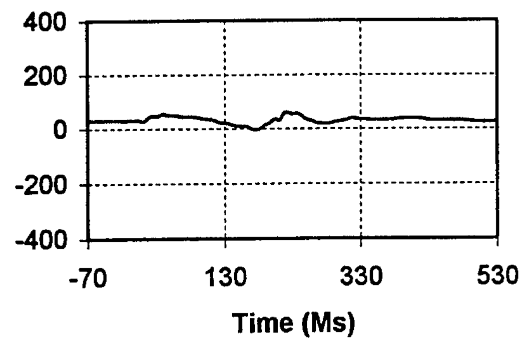


DRI Study Test: 5568 Test Date: 950928 Subj: R-20 Cell: B

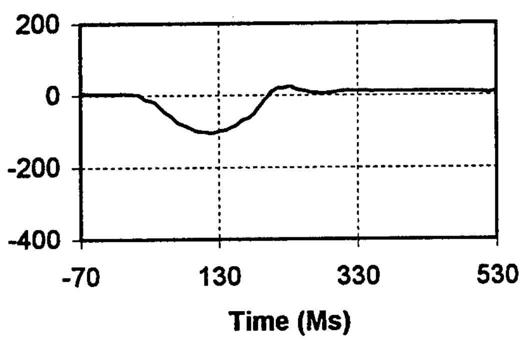
LEFT SEAT PAN X FORCE (LB)



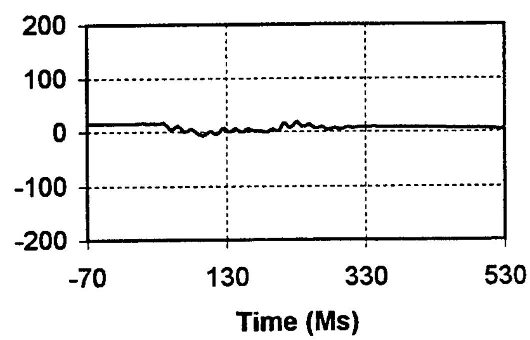
SEAT PAN X MINUS TARE (LB)



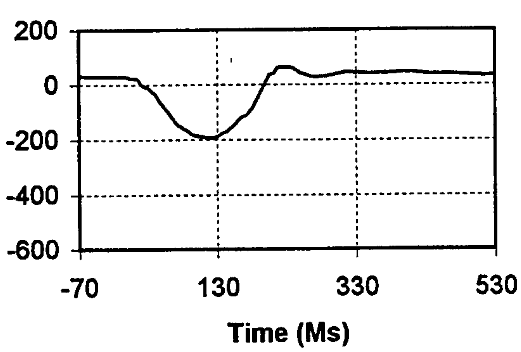
RIGHT SEAT PAN X FORCE (LB)

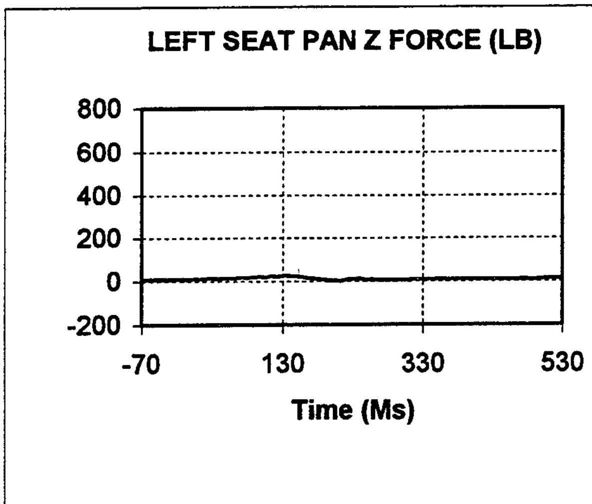


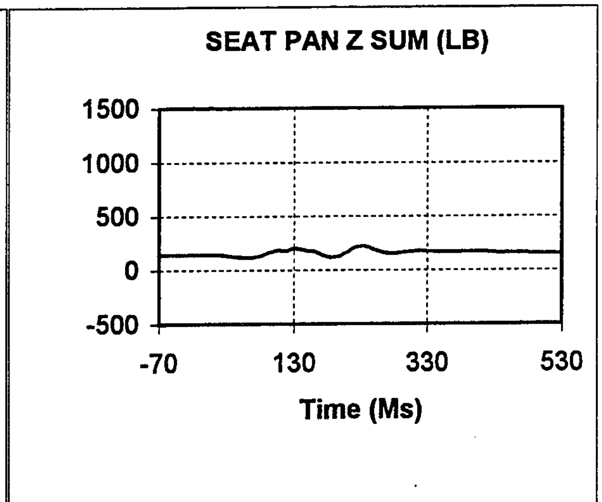
SEAT PAN Y FORCE (LB)

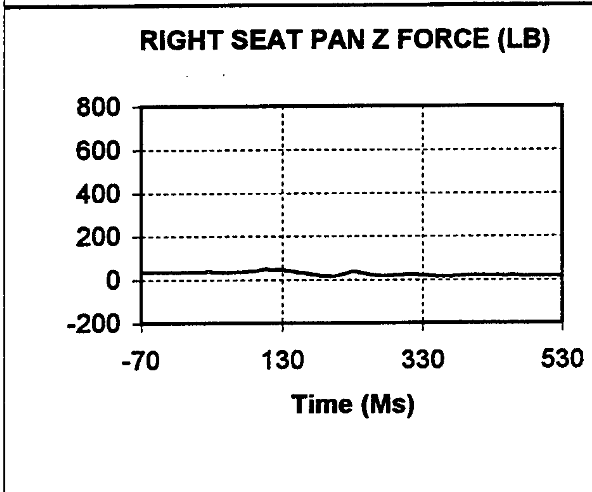


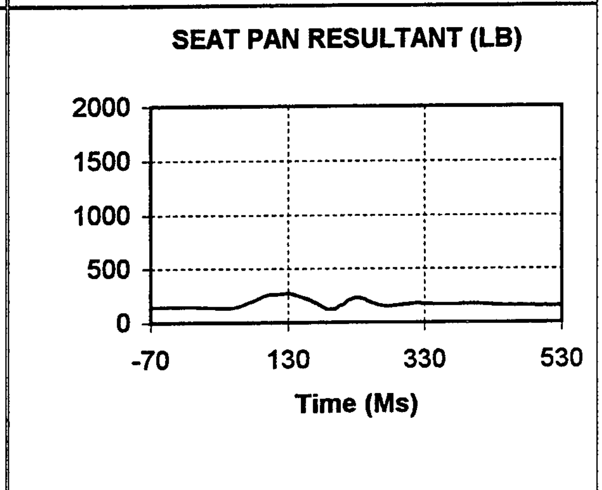
SEAT PAN X SUM (LB)

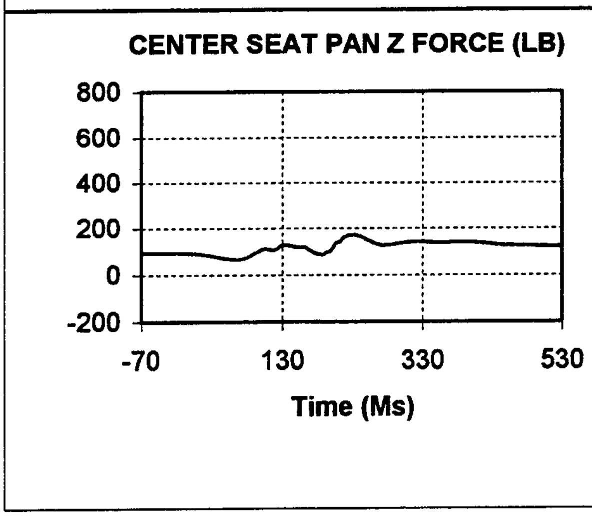


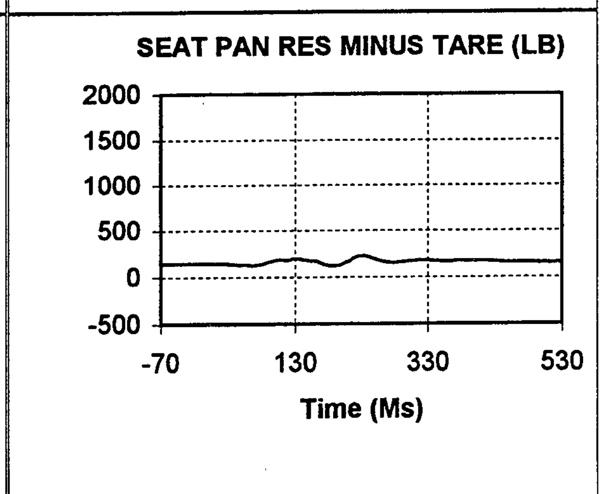

LEFT SEAT PAN Z FORCE (LB)
800
600
400
200
0
-200
-70
130
330
530
Time (Ms)


SEAT PAN Z SUM (LB)
1500
1000
500
0
-500
-70
130
330
530
Time (Ms)


RIGHT SEAT PAN Z FORCE (LB)
800
600
400
200
0
-200
-70
130
330
530
Time (Ms)


SEAT PAN RESULTANT (LB)
2000
1500
1000
500
0
-70
130
330
530
Time (Ms)


CENTER SEAT PAN Z FORCE (LB)
800
600
400
200
0
-200
-70
130
330
530
Time (Ms)


SEAT PAN RES MINUS TARE (LB)
2000
1500
1000
500
0
-500
-70
130
330
530
Time (Ms)

DRI Study Test: 5610 Test Date: 951017 Subj: M-21 Wt: 155.0
Nom G: 8.0 Cell: B 60 Hz Filter

Data ID	Immediate Preimpact	Maximum Value	Minimum Value	Time Of Maximum	Time Of Minimum
Reference Mark Time (Ms)				-80.0	
Impact Rise Time (Ms)				94.0	
Impact Duration (Ms)				198.0	
Velocity Change (Ft/Sec)		30.86			
Sled Acceleration (G)					
X Axis	0.03	7.99	-0.33	94.0	320.0
Y Axis	0.00	0.34	-0.37	74.0	84.0
Z Axis	1.00	1.13	0.38	299.0	105.0
Sled Velocity (Ft/Sec)	0.03	31.65	0.03	207.0	0.0
Seat Pan Acceleration (G)					
X Axis	-0.03	0.32	-7.83	514.0	98.0
Y Axis	0.00	1.57	-1.35	108.0	99.0
Head Acceleration (G)					
X Axis	-0.01	0.38	-7.52	481.0	142.0
Y Axis	0.02	1.45	-0.30	139.0	23.0
Z Axis	1.03	6.04	-3.55	207.0	114.0
Resultant	1.03	8.27	0.32	116.0	329.0
Ry (Rad/Sec2)	-0.53	232.31	-319.60	115.0	209.0
Chest Acceleration (G)					
X Axis	0.01	3.02	-8.61	216.0	112.0
Y Axis	0.00	0.78	-1.87	213.0	116.0
Z Axis	1.03	5.28	0.11	129.0	188.0
Resultant	1.03	9.75	0.66	111.0	315.0
Ry (Rad/Sec2)	-0.77	305.21	-291.82	189.0	210.0
T1 Acceleration (G)					
X Axis	-0.03	1.04	-8.72	210.0	130.0
Y Axis	0.00	1.62	-0.24	116.0	205.0
Z Axis	1.00	1.36	-5.89	378.0	118.0
Resultant	1.00	8.74	0.52	130.0	196.0
T1 Corrected Acceleration (G)					
X Axis	-0.02	0.91	-8.83	208.0	119.0
Z Axis	1.01	4.71	-1.98	131.0	118.0
Resultant	1.01	9.23	0.59	130.0	227.0

DRI Study Test: 5610 Test Date: 951017 Subj: M-21 Wt: 155.0
Nom G: 8.0 Cell: B 60 Hz Filter

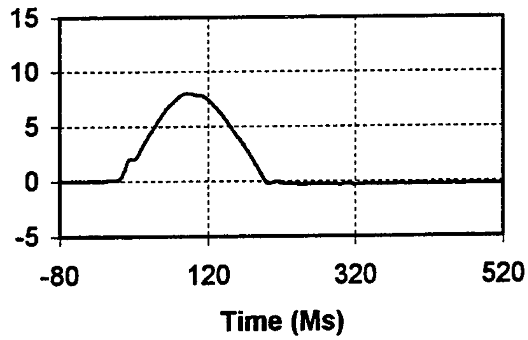
Data ID	Immediate Preimpact	Maximum Value	Minimum Value	Time Of Maximum	Time Of Minimum
Headrest Force (Lb)					
X Axis	54.79	54.59	-54.93	0.0	106.0
X Axis Minus Tare	54.93	56.32	-16.95	6.0	106.0
Y Axis	2.96	10.21	-11.04	211.0	87.0
Z Axis	-1.96	12.72	-10.36	198.0	206.0
Resultant	54.91	55.38	2.85	106.0	184.0
Resultant Minus Tare	55.04	56.45	2.15	6.0	181.0
Left Shoulder Force (Lb)					
X Axis	-47.17	-20.48	-181.89	450.0	109.0
Y Axis	5.99	27.31	3.92	113.0	463.0
Z Axis	6.25	16.18	3.63	142.0	520.0
Resultant	47.96	184.20	21.37	109.0	450.0
Right Shoulder Force (Lb)					
X Axis	-47.38	-16.34	-202.24	519.0	109.0
Y Axis	-6.54	-1.25	-26.84	496.0	112.0
Z Axis	9.57	41.02	5.73	128.0	475.0
Resultant	48.78	207.54	17.72	109.0	519.0
Left Lap Force (Lb)					
X Axis	-44.51	-14.91	-296.46	481.0	120.0
Y Axis	23.25	80.04	15.23	123.0	476.0
Z Axis	-54.04	-20.75	-239.67	517.0	118.0
Resultant	73.77	389.19	29.94	120.0	500.0
Right Lap Force (Lb)					
X Axis	-46.96	-15.26	-299.99	514.0	120.0
Y Axis	-20.11	-5.27	-78.49	520.0	118.0
Z Axis	-37.39	-2.15	-216.64	497.0	117.0
Resultant	63.31	377.81	16.46	119.0	515.0
Left Foot Force (Lb)					
X Axis	-267.53	-134.24	-380.40	206.0	85.0
Y Axis	-16.50	-5.52	-20.67	94.0	261.0
Z Axis	-85.62	-47.02	-154.86	517.0	87.0
Resultant	281.38	410.70	142.78	85.0	207.0
Right Foot Force (Lb)					
X Axis	-276.89	-123.62	-348.28	520.0	86.0
Y Axis	19.34	21.09	9.81	13.0	181.0
Z Axis	-79.87	-31.99	-131.83	516.0	87.0
Resultant	288.83	372.60	128.16	87.0	520.0

DRI Study Test: 5610 Test Date: 951017 Subj: M-21 Wt: 155.0
Nom G: 8.0 Cell: B 60 Hz Filter

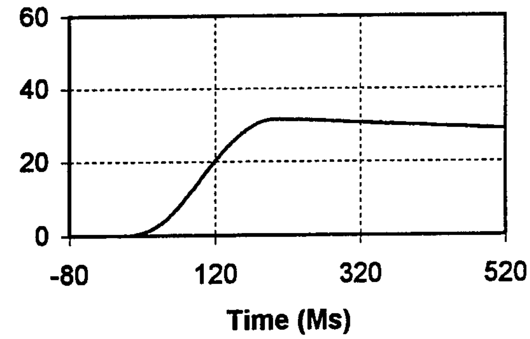
Data ID	Immediate Preimpact	Maximum Value	Minimum Value	Time Of Maximum	Time Of Minimum
Seat Back Force (Lb)					
Left X Axis	169.76	218.42	-0.06	215.0	58.0
Right X Axis	177.79	242.62	4.88	214.0	61.0
Center X Axis	295.23	317.47	-3.17	222.0	55.0
X Axis Sum	642.78	765.60	4.42	217.0	58.0
X Axis Minus Tare	643.63	762.90	103.86	216.0	171.0
Top Y Axis	9.71	35.78	-26.70	113.0	201.0
Bottom Y Axis	-33.80	16.34	-148.42	123.0	214.0
Y Axis Sum	-24.09	30.53	-161.43	118.0	101.0
Z Axis	0.10	31.72	-34.94	201.0	88.0
Resultant	643.23	781.36	8.30	217.0	62.0
Resultant Minus Tare	644.09	778.74	106.79	216.0	171.0
Seat Pan Force (Lb)					
Left X Axis	8.95	60.01	-108.29	231.0	109.0
Right X Axis	-8.30	38.81	-118.22	224.0	101.0
X Axis Sum	0.65	95.47	-218.72	226.0	106.0
X Axis Minus Tare	1.43	88.49	-11.59	227.0	133.0
Y Axis	-3.42	22.35	-33.16	110.0	81.0
Left Z Axis	7.31	34.16	-0.72	120.0	205.0
Right Z Axis	5.86	57.75	0.96	128.0	520.0
Center Z Axis	82.54	268.29	68.67	232.0	47.0
Z Axis Sum	95.71	351.57	95.07	138.0	24.0
Resultant	95.78	397.27	96.20	136.0	3.0
Resultant Minus Tare	95.78	351.73	96.30	138.0	0.0

DRI Study Test: 5610 Test Date: 951017 Subj: M-21 Cell: B

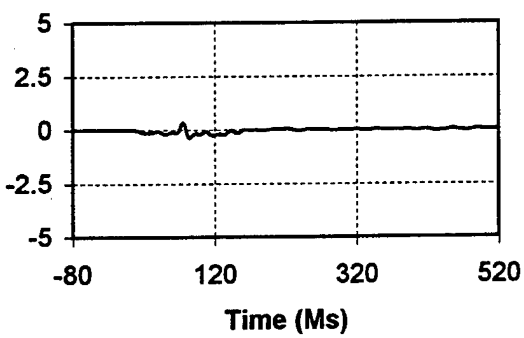
SLED X ACCEL (G)



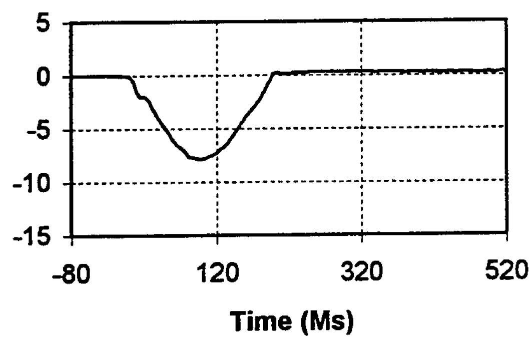
SLED VELOCITY (FT/SEC)



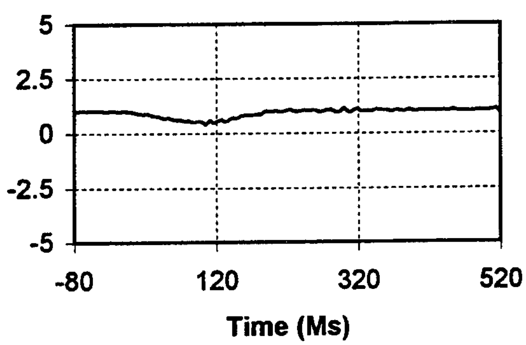
SLED Y ACCEL (G)



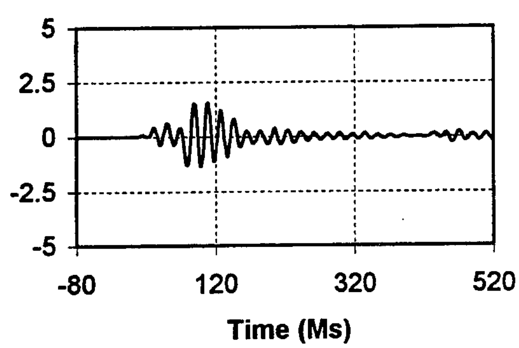
SEAT PAN X ACCEL (G)



SLED Z ACCEL (G)



SEAT PAN Y ACCEL (G)



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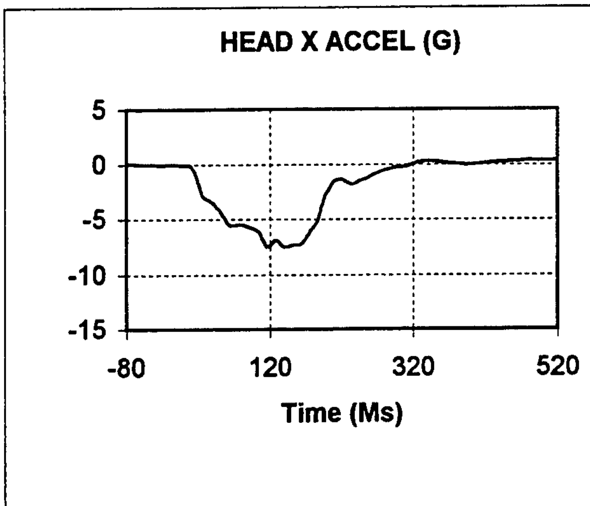
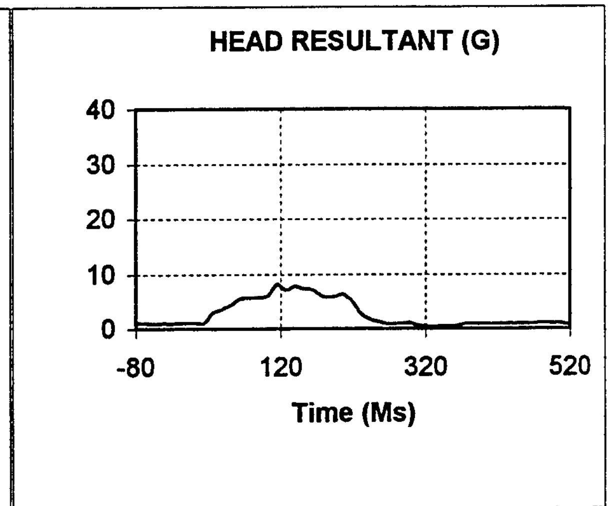
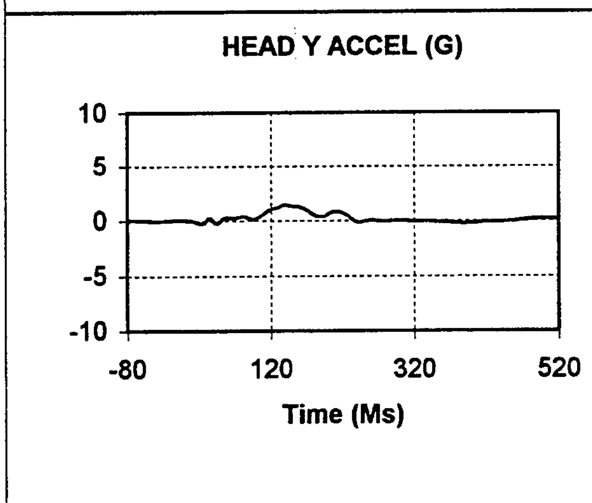
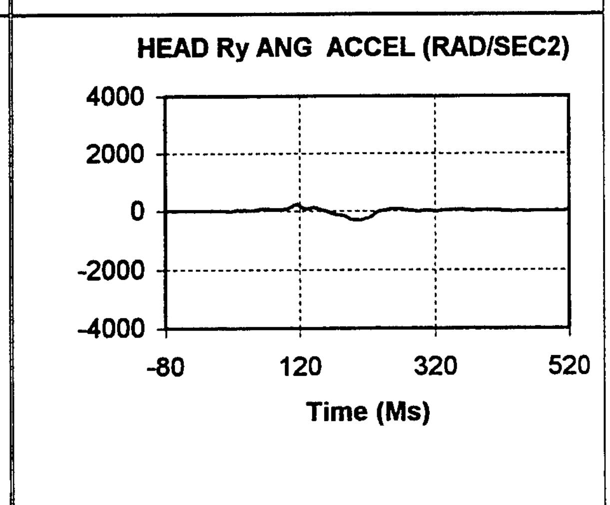
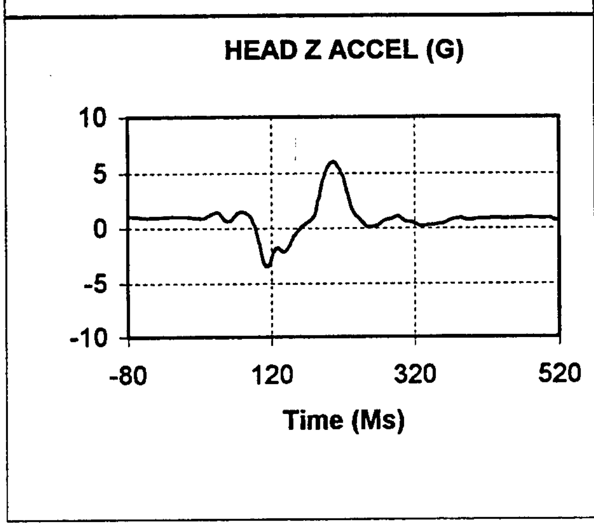
DRI Study Test: 5610 Test Date: 951017 Subj: M-21 Cell: B



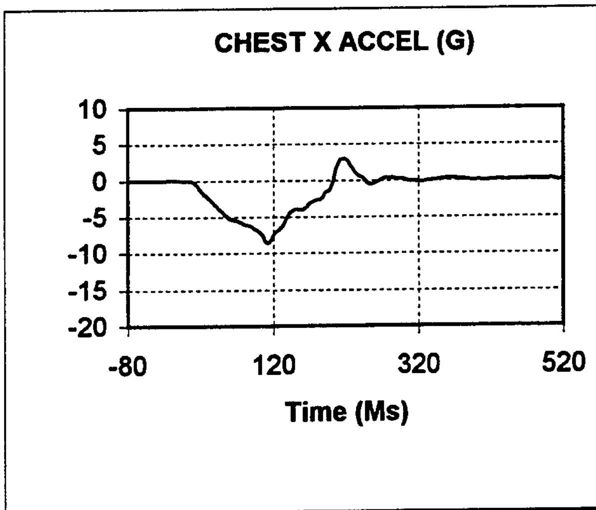


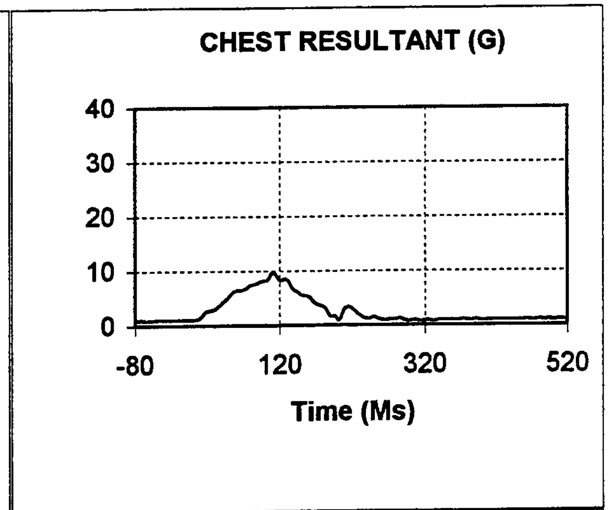


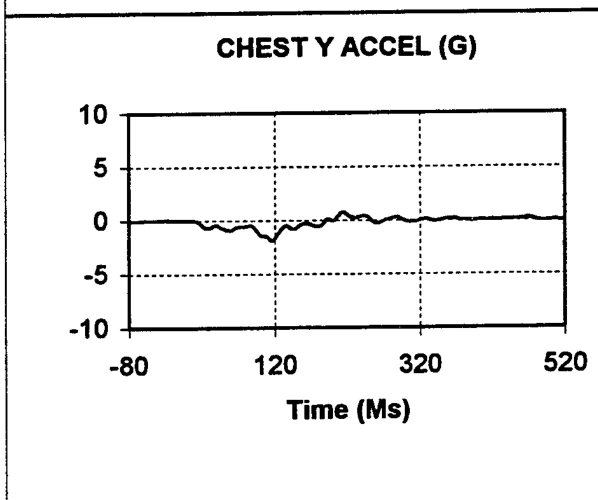


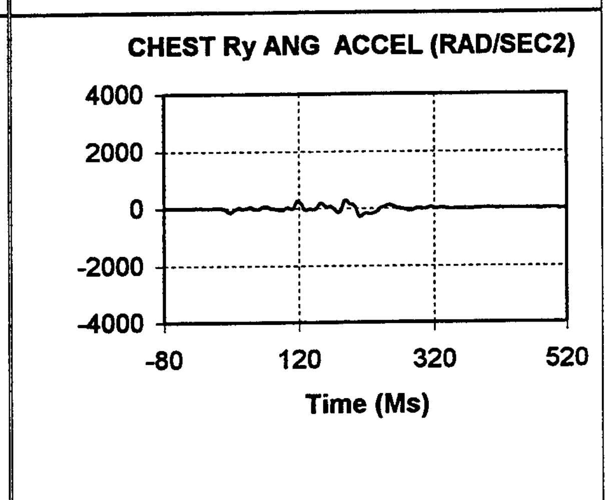


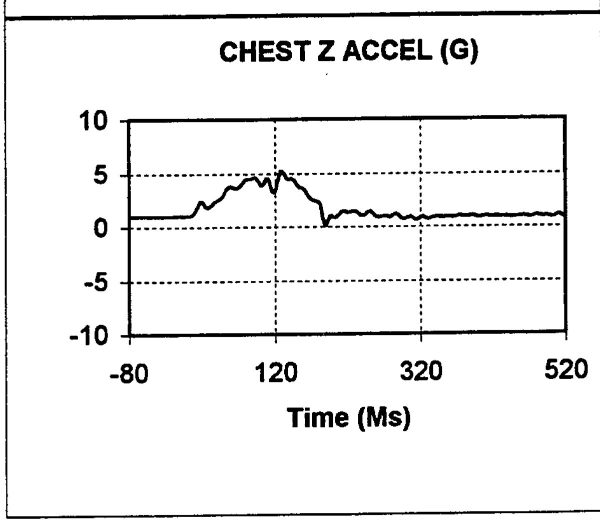
DRI Study Test: 5610 Test Date: 951017 Subj: M-21 Cell: B





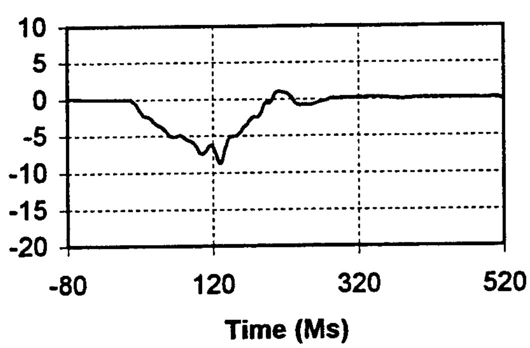




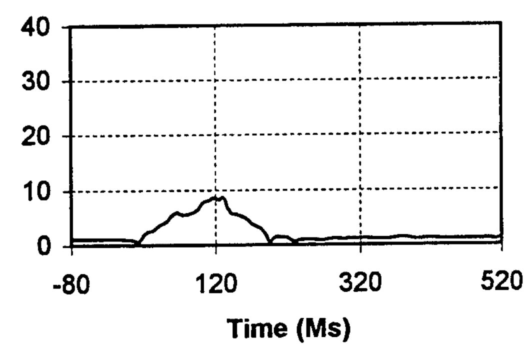


DRI Study Test: 5610 Test Date: 951017 Subj: M-21 Cell: B

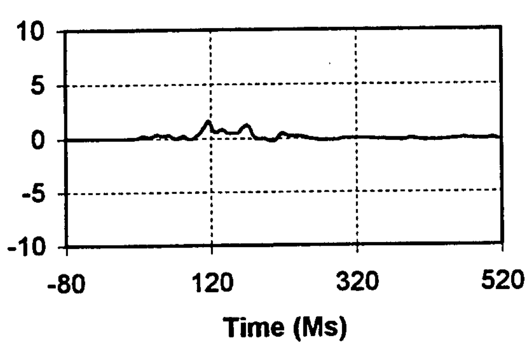
T1 X ACCEL (G)



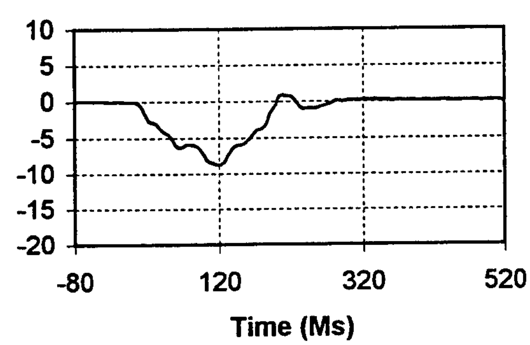
T1 RESULTANT (G)



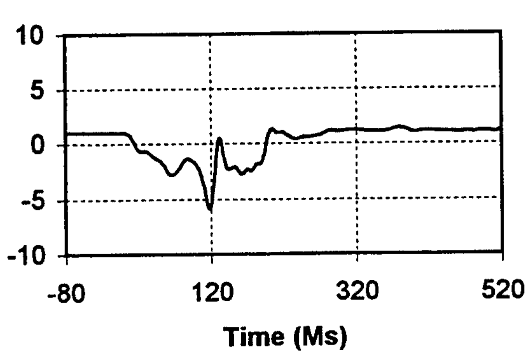
T1 Y ACCEL (G)



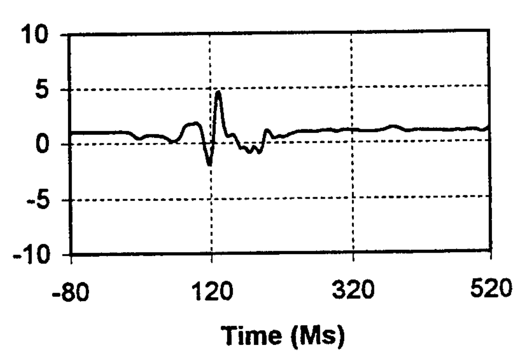
CORRECTED T1 X ACCEL (G)



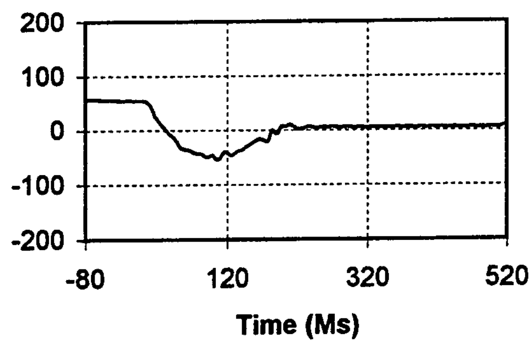
T1 Z ACCEL (G)



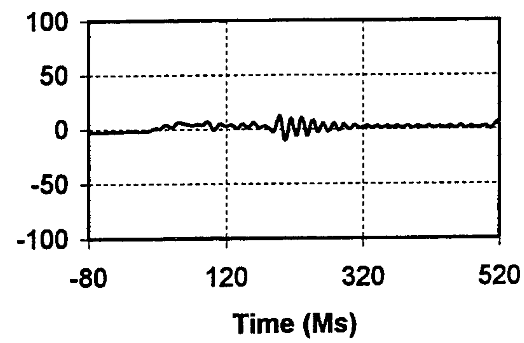
CORRECTED T1 Z ACCEL (G)



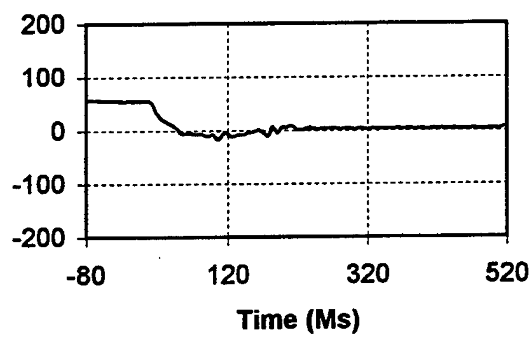
HEADREST X FORCE (LB)



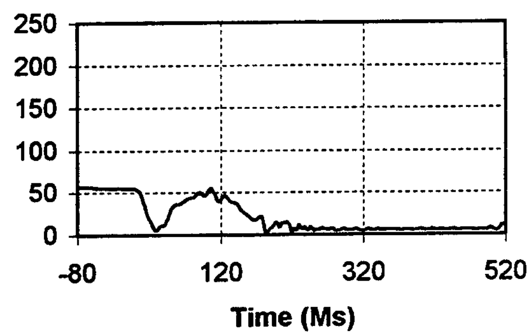
HEADREST Z FORCE (LB)



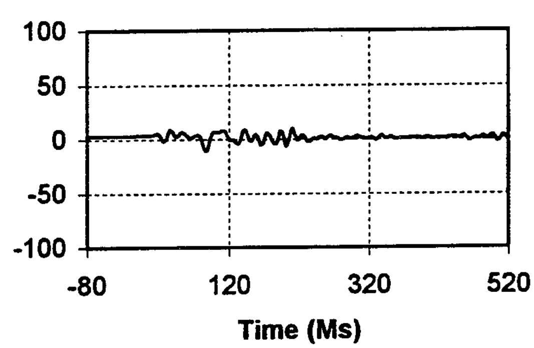
HEADREST X MINUS TARE (LB)



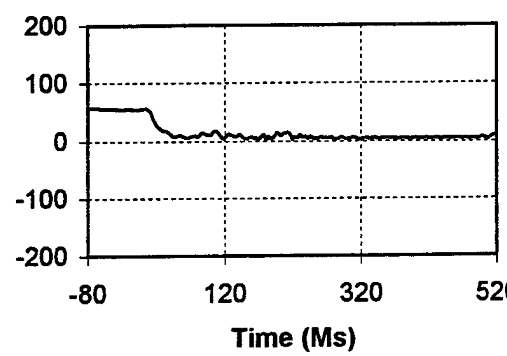
HEADREST RESULTANT (LB)



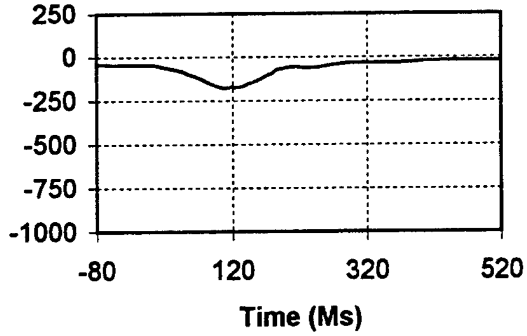
HEADREST Y FORCE (LB)



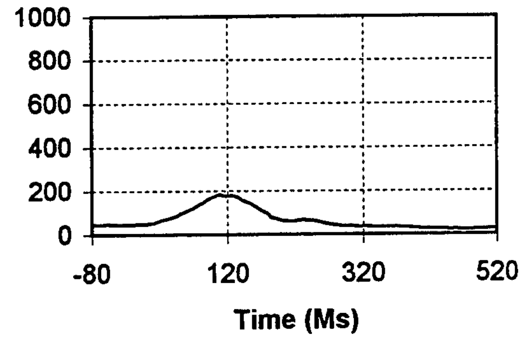
HEADREST RES MINUS TARE (LB)



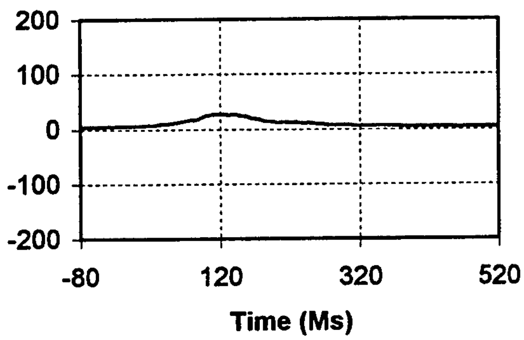
LEFT SHOULDER X FORCE (LB)



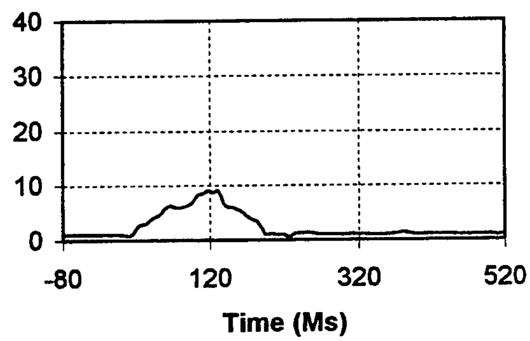
LEFT SHOULDER RESULTANT (LB)



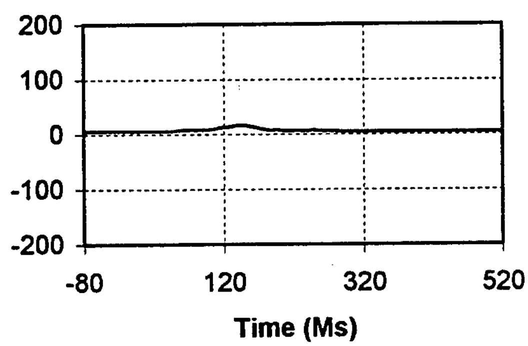
LEFT SHOULDER Y FORCE (LB)

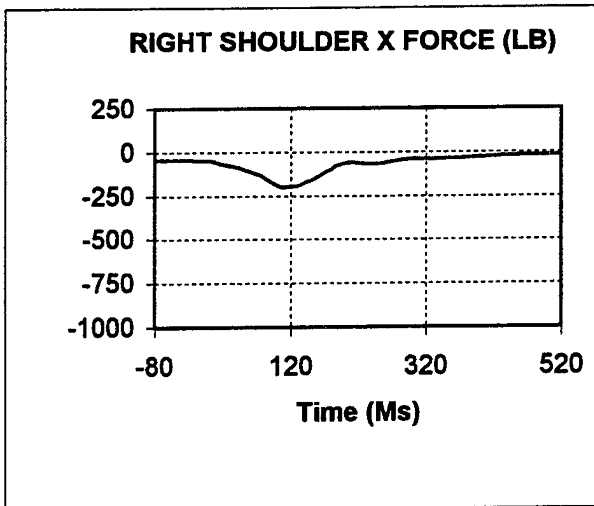


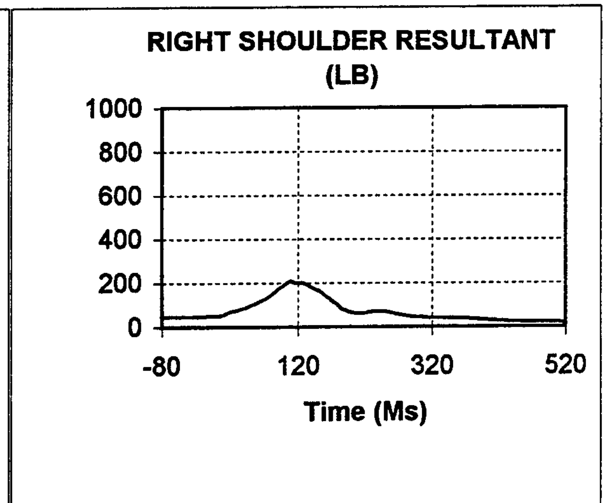
CORRECTED T1 RESULTANT (G)

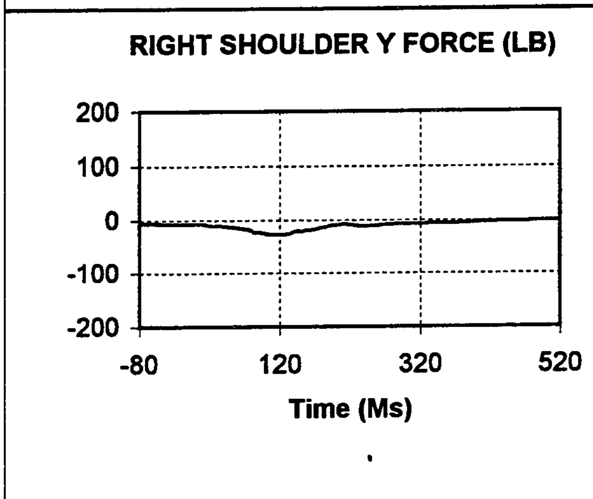


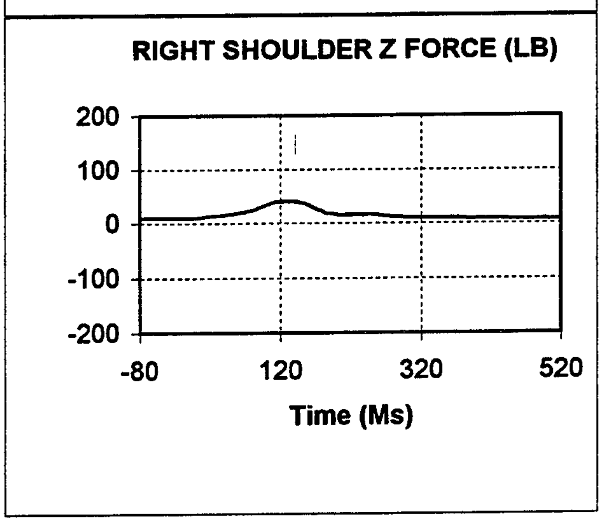
LEFT SHOULDER Z FORCE (LB)



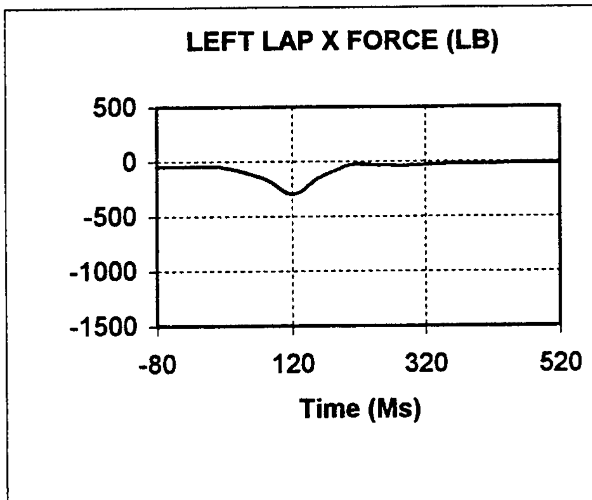

RIGHT SHOULDER X FORCE (LB)
250
0
-250
-500
-750
-1000
-80
120
320
520
Time (Ms)

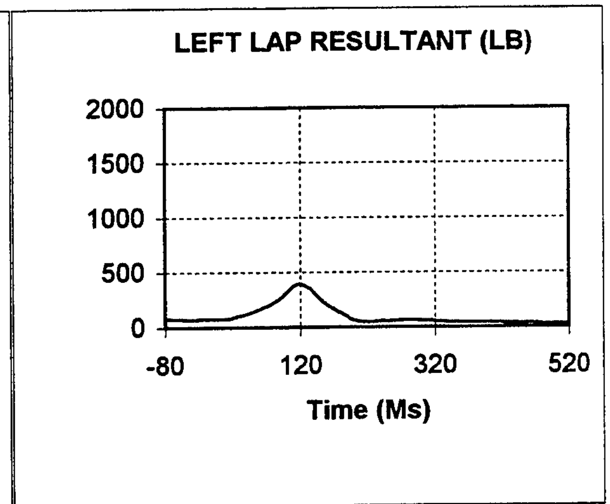

RIGHT SHOULDER RESULTANT (LB)
1000
800
600
400
200
0
-80
120
320
520
Time (Ms)

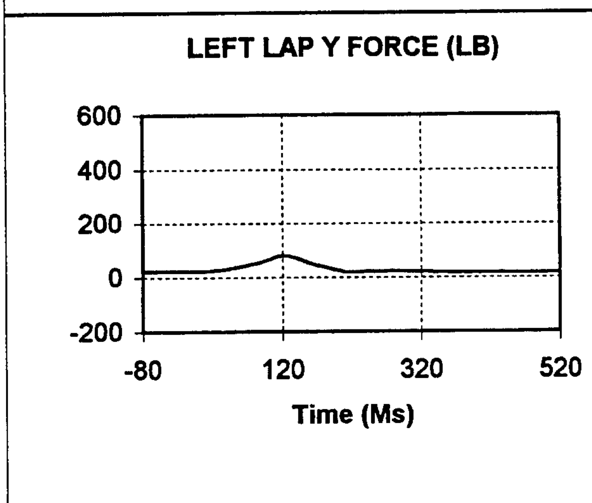

RIGHT SHOULDER Y FORCE (LB)
200
100
0
-100
-200
-80
120
320
520
Time (Ms)

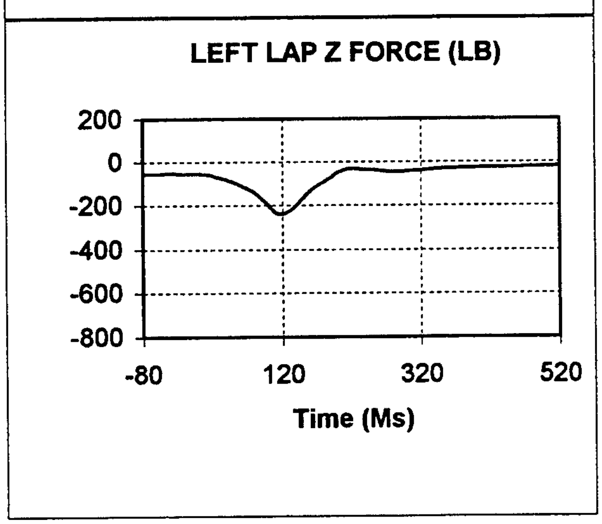

RIGHT SHOULDER Z FORCE (LB)
200
100
0
-100
-200
-80
120
320
520
Time (Ms)

DRI Study Test: 5610 Test Date: 951017 Subj: M-21 Cell: B

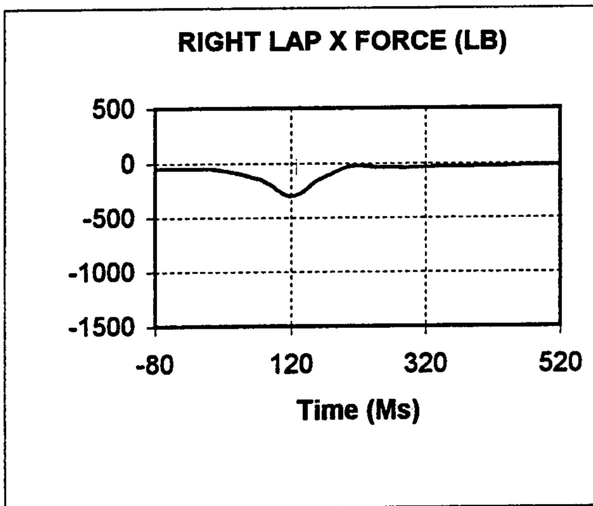


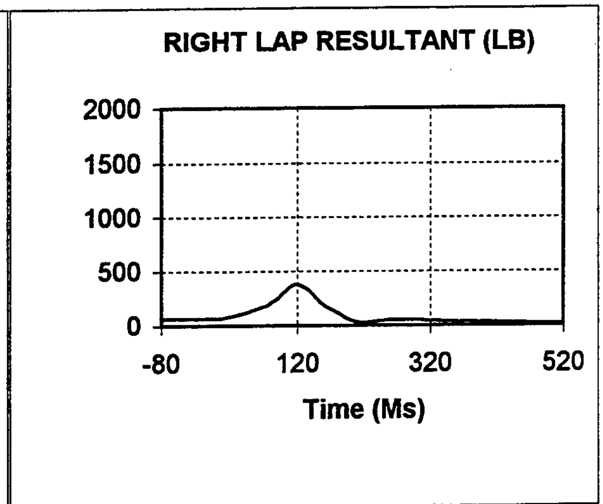


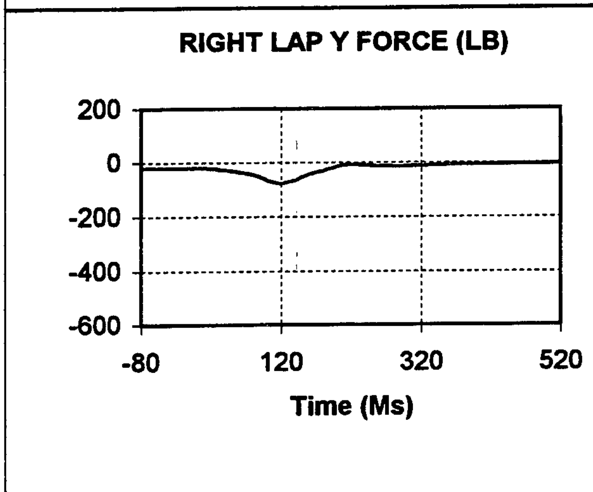


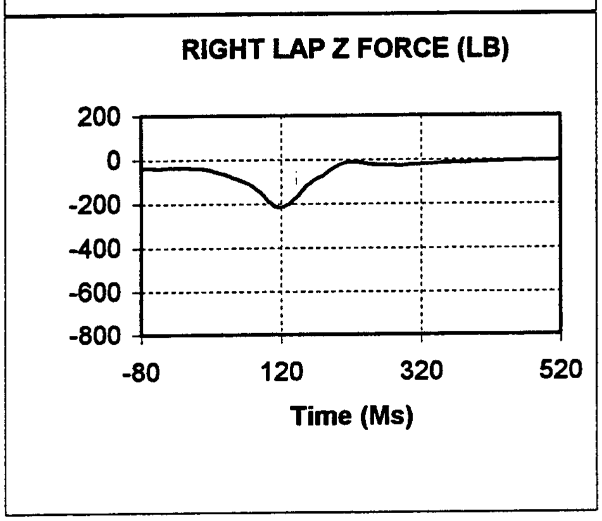


DRI Study Test: 5610 Test Date: 951017 Subj: M-21 Cell: B

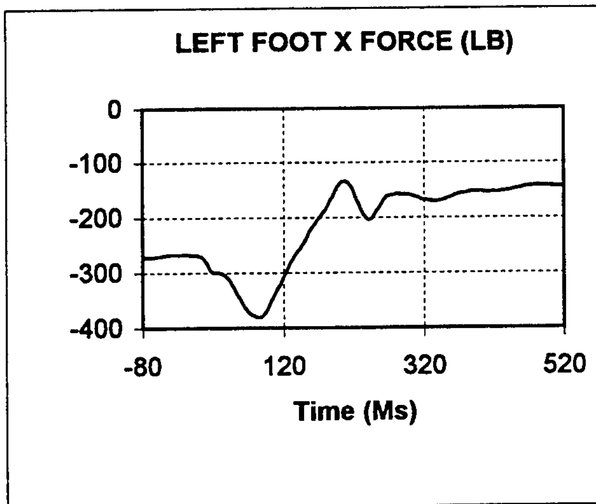


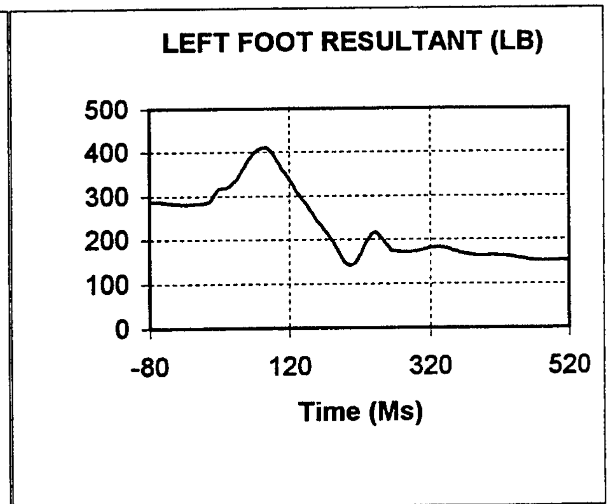


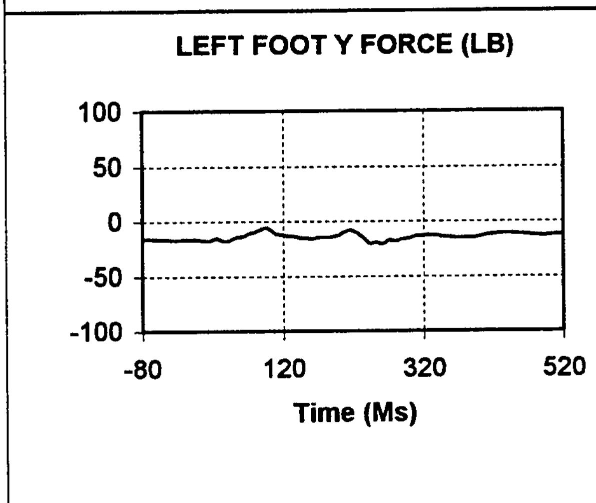


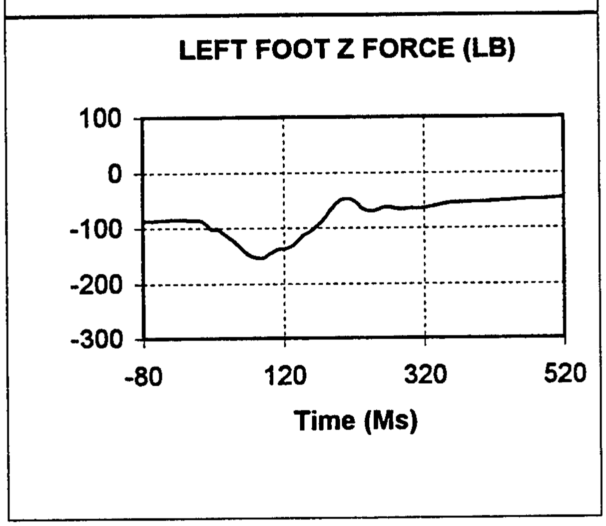


DRI Study Test: 5610 Test Date: 951017 Subj: M-21 Cell: B









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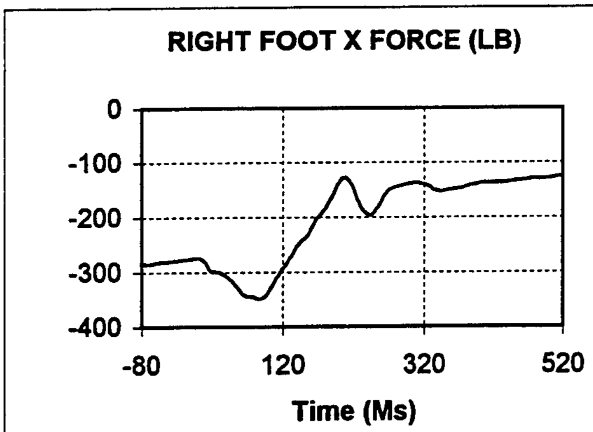
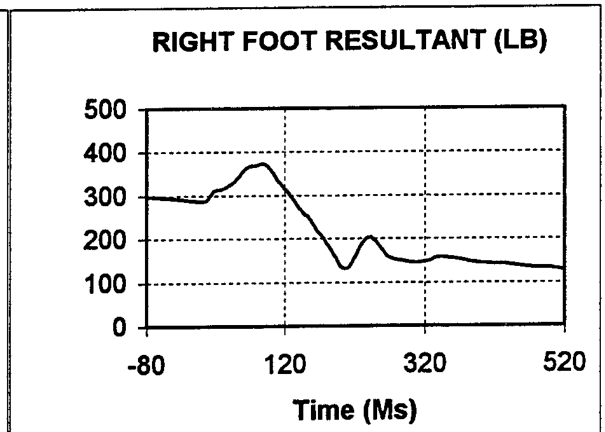
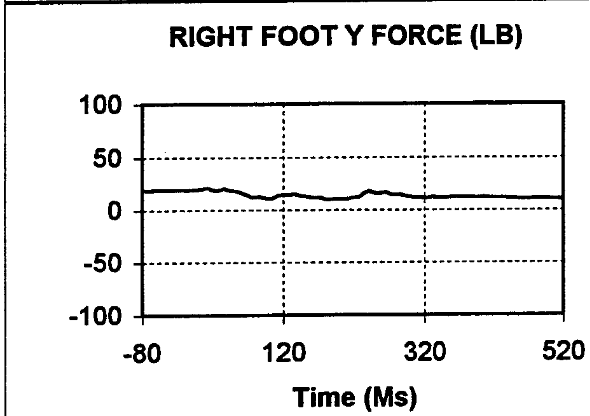
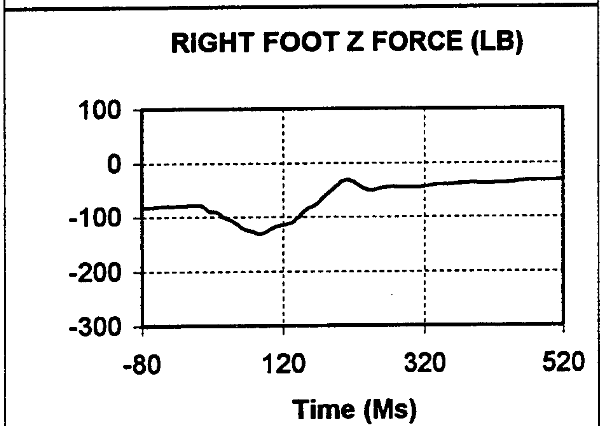
DRI Study Test: 5610 Test Date: 951017 Subj: M-21 Cell: B

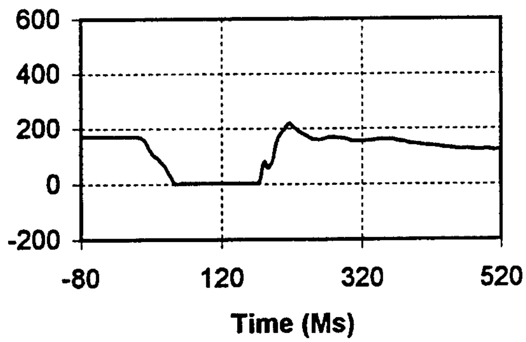




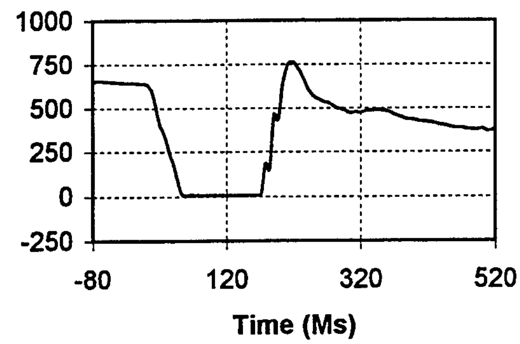




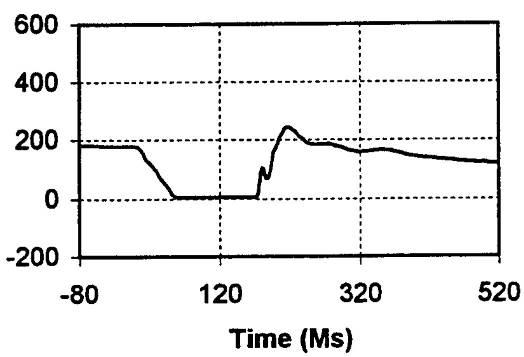
LEFT SEAT BACK X FORCE (LB)



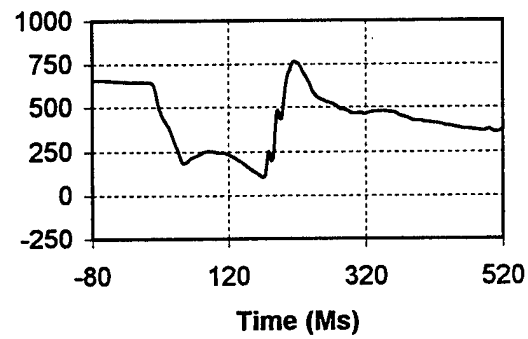
SEAT BACK X SUM (LB)



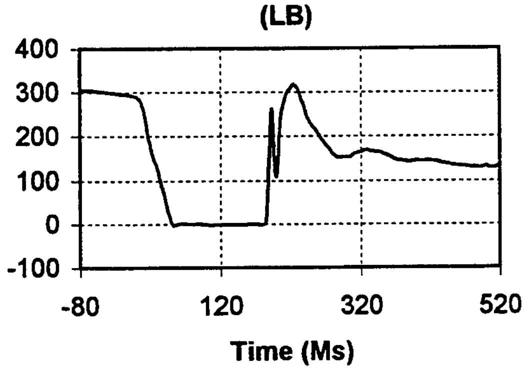
RIGHT SEAT BACK X FORCE (LB)

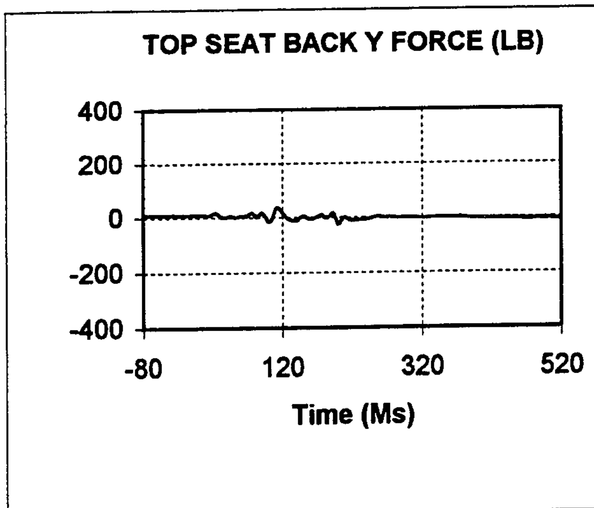


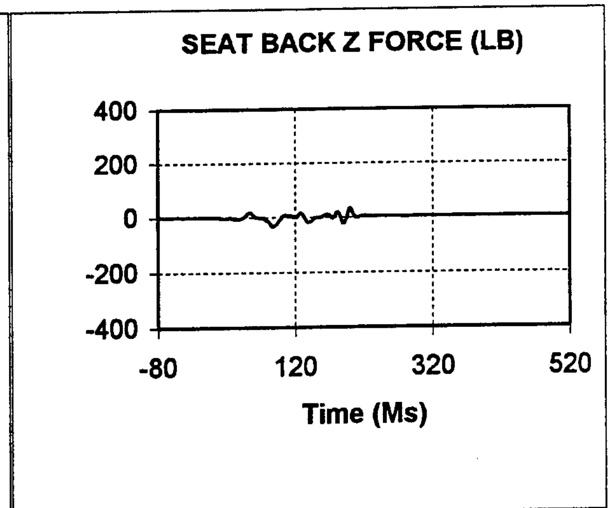
SEAT BACK X MINUS TARE (LB)

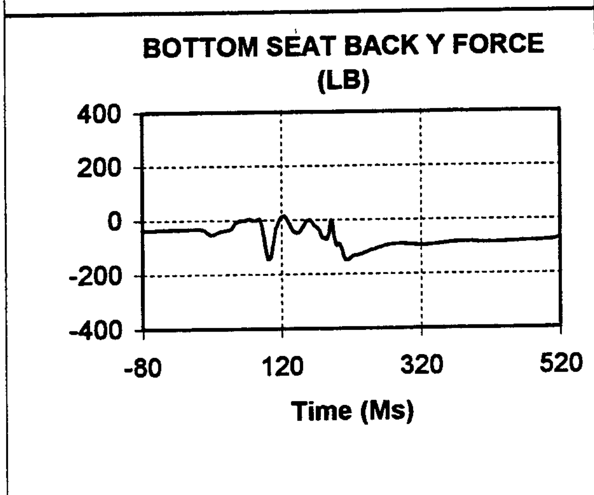


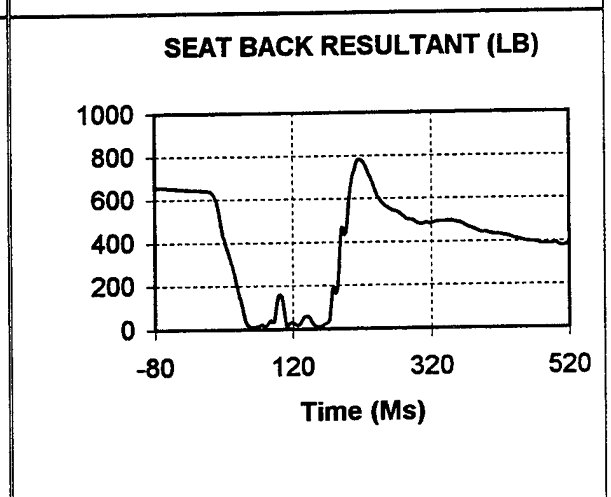
CENTER SEAT BACK X FORCE (LB)

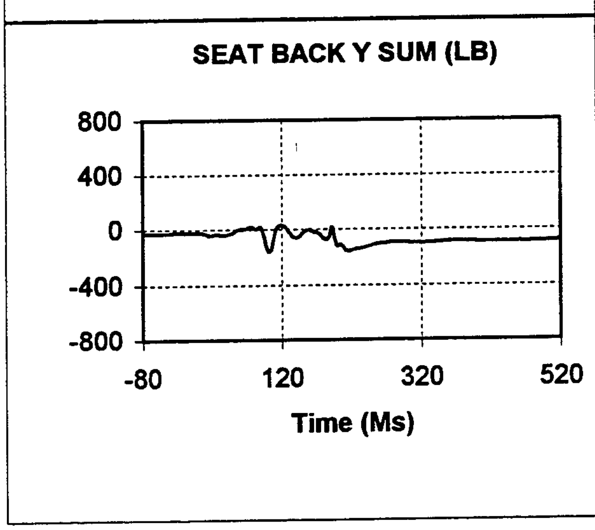


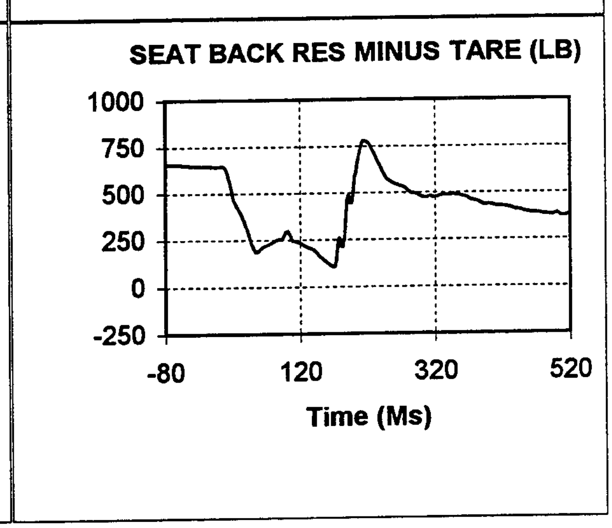

TOP SEAT BACK Y FORCE (LB)
400
200
0
-200
-400
-80
120
320
520
Time (Ms)

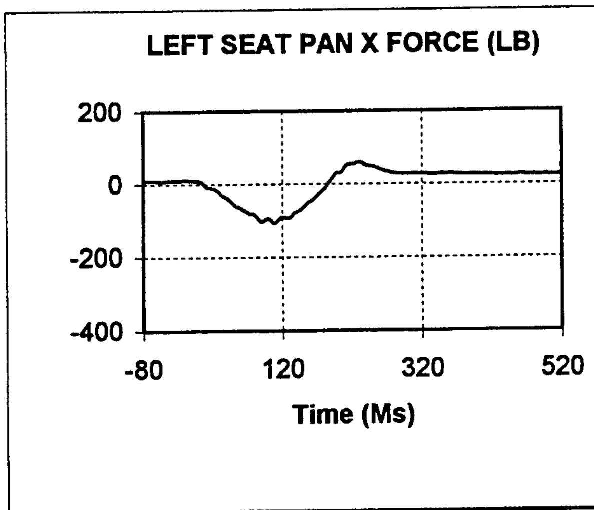

SEAT BACK Z FORCE (LB)
400
200
0
-200
-400
-80
120
320
520
Time (Ms)

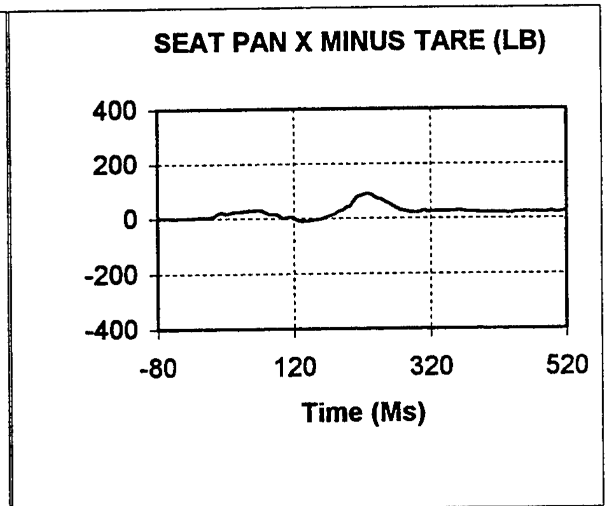

BOTTOM SEAT BACK Y FORCE (LB)
400
200
0
-200
-400
-80
120
320
520
Time (Ms)

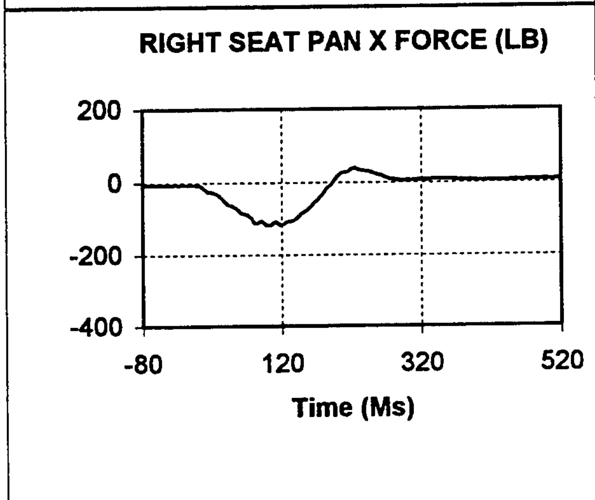

SEAT BACK RESULTANT (LB)
1000
800
600
400
200
0
-80
120
320
520
Time (Ms)

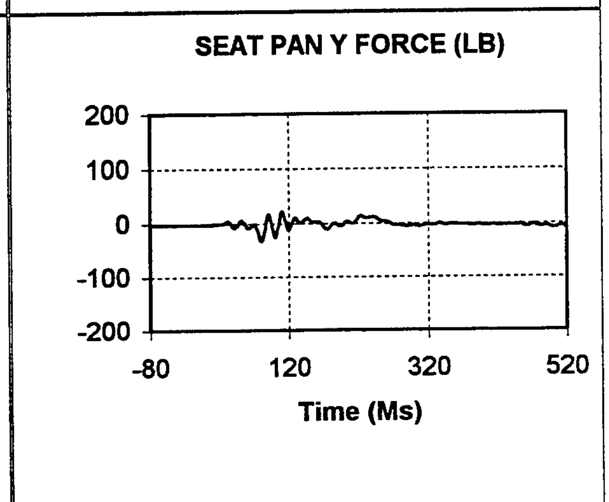

SEAT BACK Y SUM (LB)
800
400
0
-400
-800
-80
120
320
520
Time (Ms)

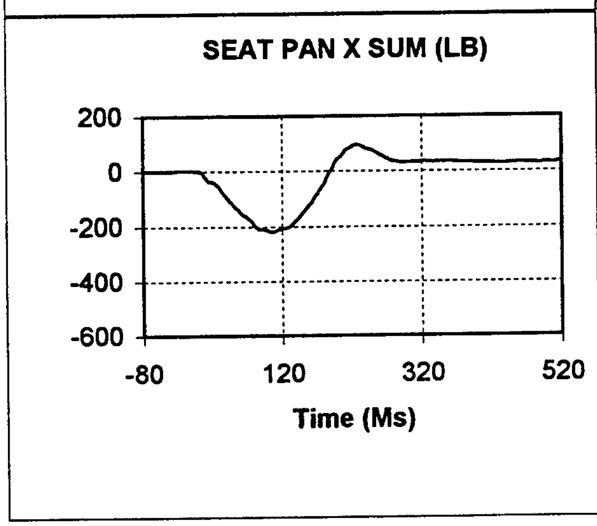

SEAT BACK RES MINUS TARE (LB)
1000
750
500
250
0
-250
-80
120
320
520
Time (Ms)


LEFT SEAT PAN X FORCE (LB)
200
0
-200
-400
-80
120
320
520
Time (Ms)

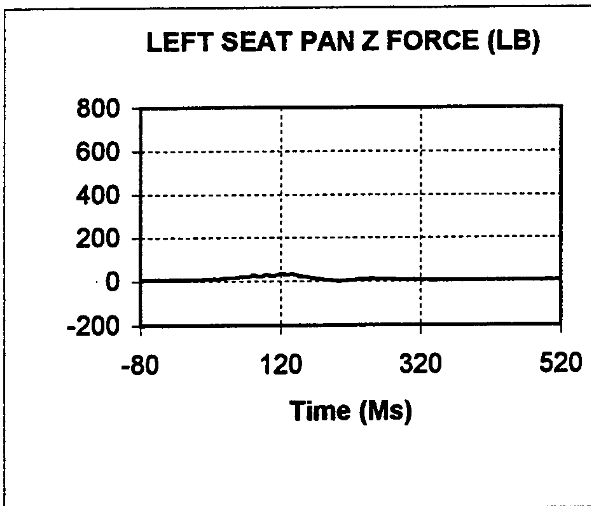

SEAT PAN X MINUS TARE (LB)
400
200
0
-200
-400
-80
120
320
520
Time (Ms)

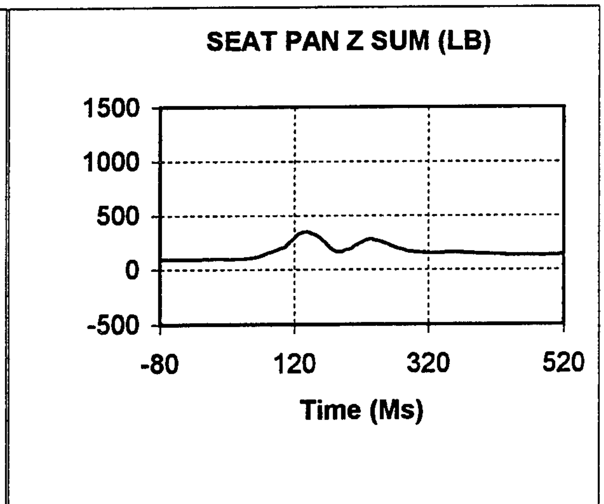

RIGHT SEAT PAN X FORCE (LB)
200
0
-200
-400
-80
120
320
520
Time (Ms)

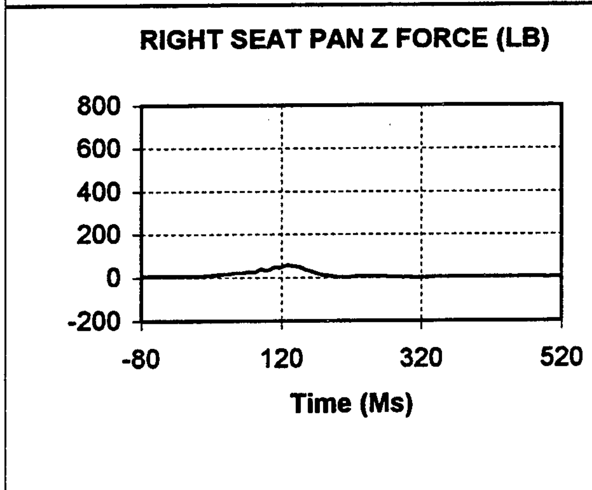

SEAT PAN Y FORCE (LB)
200
100
0
-100
-200
-80
120
320
520
Time (Ms)

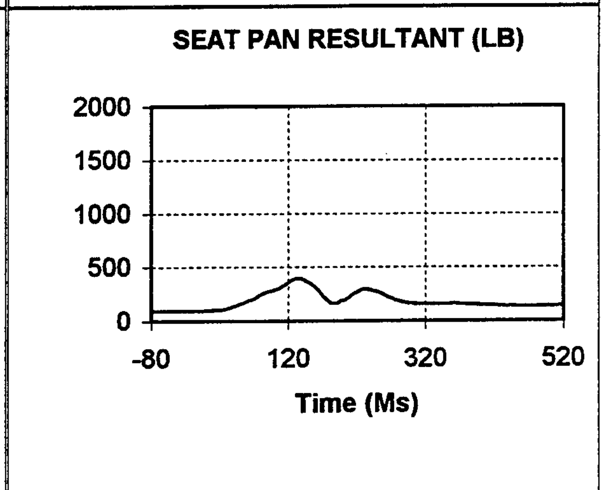

SEAT PAN X SUM (LB)
200
0
-200
-400
-600
-80
120
320
520
Time (Ms)

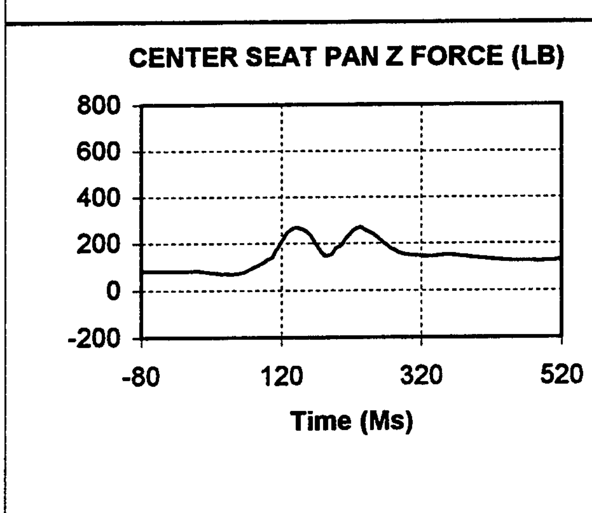
DRI Study Test: 5610 Test Date: 951017 Subj: M-21 Cell: B

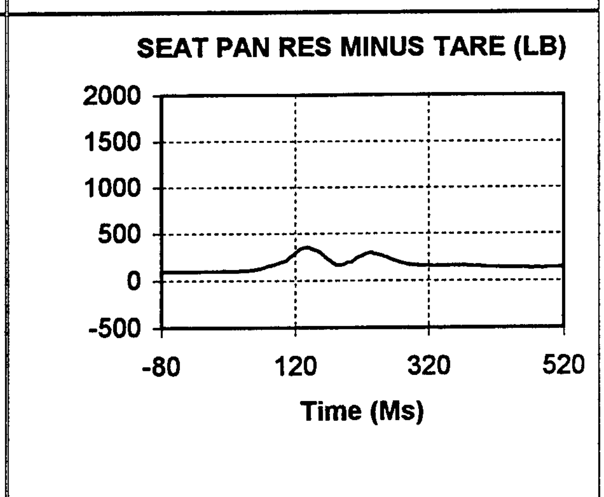












DRI Study Test: 5630 Test Date: 951031 Subj: V-3 Wt: 116.0
Nom G: 10.0 Cell: C 60 Hz Filter

Data ID	Immediate Preimpact	Maximum Value	Minimum Value	Time Of Maximum	Time Of Minimum
Reference Mark Time (Ms)				-94.0	
Impact Rise Time (Ms)				96.0	
Impact Duration (Ms)				208.0	
Velocity Change (Ft/Sec)		39.65			
Sled Acceleration (G)					
X Axis	0.02	9.92	-0.36	96.0	304.0
Y Axis	0.00	0.39	-0.52	65.0	75.0
Z Axis	1.00	1.18	0.23	259.0	83.0
Sled Velocity (Ft/Sec)	0.10	40.55	0.08	212.0	0.0
Seat Pan Acceleration (G)					
X Axis	-0.02	0.39	-9.65	422.0	105.0
Y Axis	0.00	1.45	-0.98	98.0	127.0
Head Acceleration (G)					
X Axis	-0.02	2.56	-12.99	419.0	119.0
Y Axis	0.01	0.53	-0.57	444.0	164.0
Z Axis	0.98	5.21	-11.79	226.0	112.0
Resultant	0.98	16.98	0.27	114.0	361.0
Ry (Rad/Sec2)	-0.27	560.97	-527.69	114.0	171.0
Chest Acceleration (G)					
X Axis	-0.02	2.84	-11.41	223.0	108.0
Y Axis	0.00	1.09	-2.44	220.0	165.0
Z Axis	1.01	6.01	0.43	110.0	211.0
Resultant	1.01	12.94	0.59	108.0	254.0
Ry (Rad/Sec2)	-0.62	637.00	-757.30	176.0	164.0
T1 Acceleration (G)					
X Axis	-0.01	0.91	-9.74	418.0	103.0
Y Axis	0.00	2.54	-1.28	115.0	141.0
Z Axis	0.99	2.18	-8.36	220.0	115.0
Resultant	0.99	11.56	0.30	107.0	254.0
T1 Corrected Acceleration (G)					
X Axis	-0.01	1.23	-11.82	419.0	106.0
Z Axis	0.99	1.88	-3.94	219.0	157.0
Resultant	0.99	12.03	0.50	107.0	248.0

DRI Study Test: 5630 Test Date: 951031 Subj: V-3 Wt: 116.0
Nom G: 10.0 Cell: C 60 Hz Filter

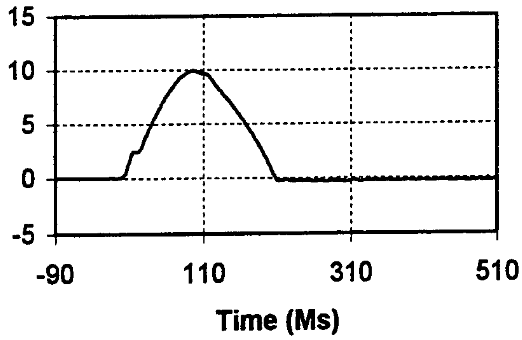
Data ID	Immediate Preimpact	Maximum Value	Minimum Value	Time Of Maximum	Time Of Minimum
Headrest Force (Lb)					
X Axis	46.38	45.99	-69.44	0.0	107.0
X Axis Minus Tare	46.50	47.80	-22.12	6.0	107.0
Y Axis	-1.49	17.26	-15.58	93.0	76.0
Z Axis	0.10	11.62	-3.48	96.0	217.0
Resultant	46.40	70.19	2.71	107.0	23.0
Resultant Minus Tare	46.52	47.82	1.46	6.0	195.0
Left Shoulder Force (Lb)					
X Axis	-56.84	-30.20	-227.47	396.0	108.0
Y Axis	9.38	33.72	6.57	105.0	430.0
Z Axis	16.80	50.83	7.84	112.0	431.0
Resultant	60.01	235.20	32.18	108.0	416.0
Right Shoulder Force (Lb)					
X Axis	-55.09	-20.09	-209.44	412.0	105.0
Y Axis	-5.47	-1.77	-23.23	219.0	115.0
Z Axis	20.71	66.46	8.23	109.0	430.0
Resultant	59.10	220.60	22.17	105.0	412.0
Left Lap Force (Lb)					
X Axis	-52.05	-34.08	-335.80	506.0	118.0
Y Axis	37.89	142.72	27.44	118.0	255.0
Z Axis	-65.49	-43.52	-269.67	506.0	117.0
Resultant	91.84	453.51	62.45	118.0	506.0
Right Lap Force (Lb)					
X Axis	-41.88	-26.95	-299.38	451.0	116.0
Y Axis	-31.77	-22.17	-122.01	483.0	114.0
Z Axis	-42.27	-19.44	-234.31	231.0	116.0
Resultant	67.45	399.11	40.39	116.0	494.0
Left Foot Force (Lb)					
X Axis	-222.41	-120.98	-317.79	242.0	74.0
Y Axis	-26.23	-9.94	-29.58	202.0	65.0
Z Axis	-68.98	-29.82	-128.14	215.0	79.0
Resultant	234.33	343.48	125.86	74.0	242.0
Right Foot Force (Lb)					
X Axis	-208.07	-118.84	-347.38	247.0	103.0
Y Axis	27.77	37.47	11.37	102.0	215.0
Z Axis	-59.69	-23.38	-147.38	239.0	104.0
Resultant	218.23	379.19	122.14	103.0	246.0

DRI Study Test: 5630 Test Date: 951031 Subj: V-3 Wt: 116.0
Nom G: 10.0 Cell: C 60 Hz Filter

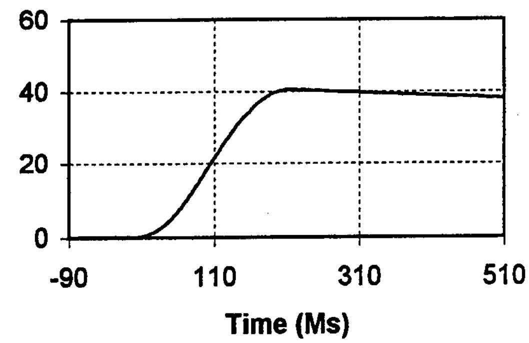
Data ID	Immediate Preimpact	Maximum Value	Minimum Value	Time Of Maximum	Time Of Minimum
Seat Back Force (Lb)					
Left X Axis	143.36	149.63	1.45	222.0	56.0
Right X Axis	144.16	166.85	3.91	195.0	55.0
Center X Axis	298.14	296.68	-2.28	0.0	74.0
X Axis Sum	585.65	583.45	6.88	0.0	74.0
X Axis Minus Tare	586.40	590.34	156.11	7.0	172.0
Top Y Axis	4.30	44.34	-15.85	94.0	104.0
Bottom Y Axis	-34.77	59.68	-74.42	100.0	118.0
Y Axis Sum	-30.47	76.16	-85.85	98.0	118.0
Z Axis	5.27	60.61	-64.93	102.0	113.0
Resultant	586.47	584.26	13.26	0.0	147.0
Resultant Minus Tare	587.22	591.13	162.90	7.0	173.0
Seat Pan Force (Lb)					
Left X Axis	14.74	39.63	-112.57	216.0	81.0
Right X Axis	-5.47	20.48	-208.18	213.0	120.0
X Axis Sum	9.27	59.45	-293.14	215.0	102.0
X Axis Minus Tare	9.96	52.40	-18.47	216.0	104.0
Y Axis	11.12	106.73	-15.93	101.0	71.0
Left Z Axis	9.11	28.28	-0.92	71.0	117.0
Right Z Axis	21.03	114.46	6.93	125.0	254.0
Center Z Axis	83.65	191.70	65.26	134.0	44.0
Z Axis Sum	113.79	299.08	101.09	126.0	428.0
Resultant	114.71	409.23	107.14	122.0	428.0
Resultant Minus Tare	114.77	314.85	105.30	127.0	428.0

DRI Study Test: 5630 Test Date: 951031 Subj: V-3 Cell: C

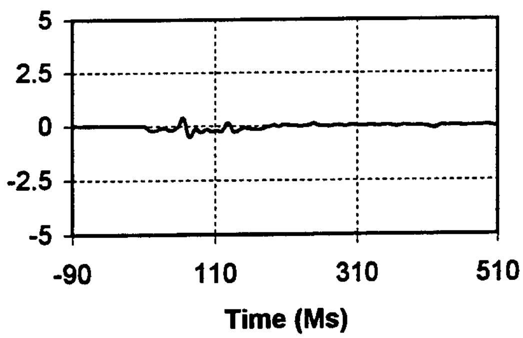
SLED X ACCEL (G)



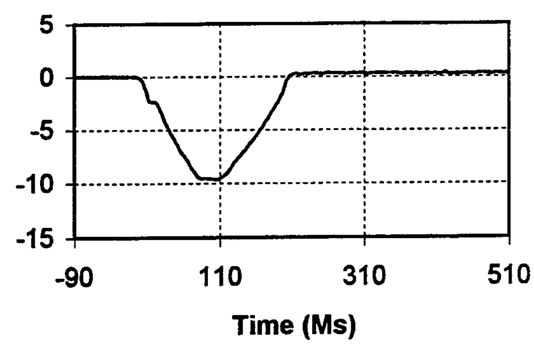
SLED VELOCITY (FT/SEC)



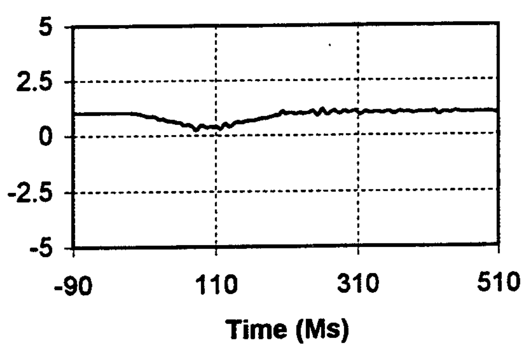
SLED Y ACCEL (G)



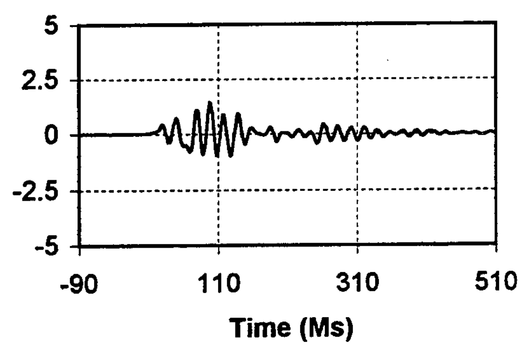
SEAT PAN X ACCEL (G)



SLED Z ACCEL (G)

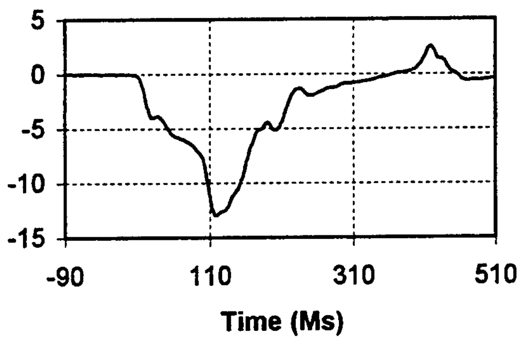


SEAT PAN Y ACCEL (G)

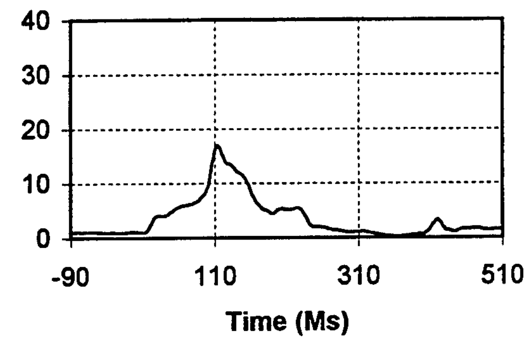


DRI Study Test: 5630 Test Date: 951031 Subj: V-3 Cell: C

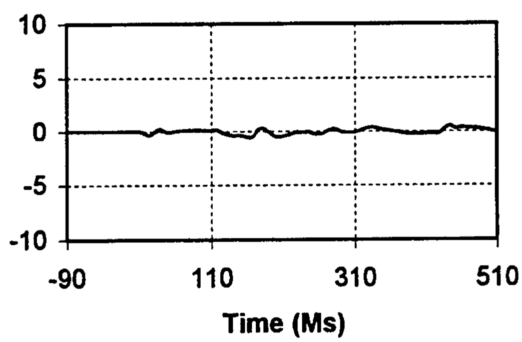
HEAD X ACCEL (G)



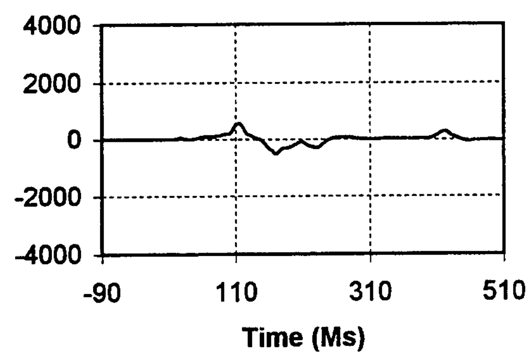
HEAD RESULTANT (G)



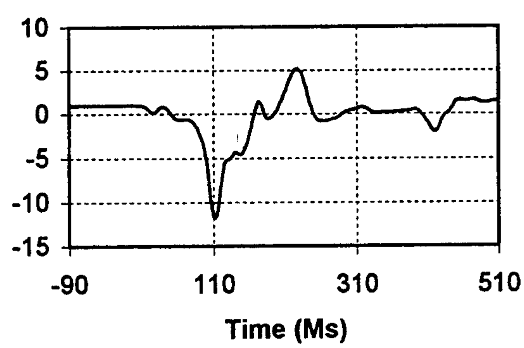
HEAD Y ACCEL (G)



HEAD Ry ANG ACCEL (RAD/SEC2)

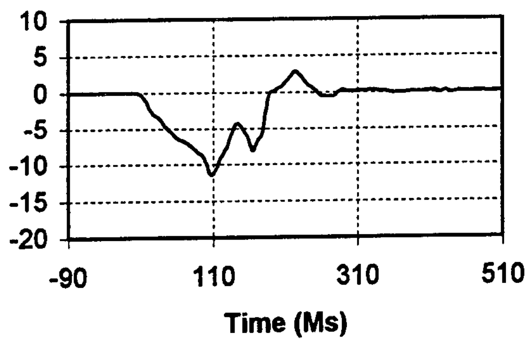


HEAD Z ACCEL (G)

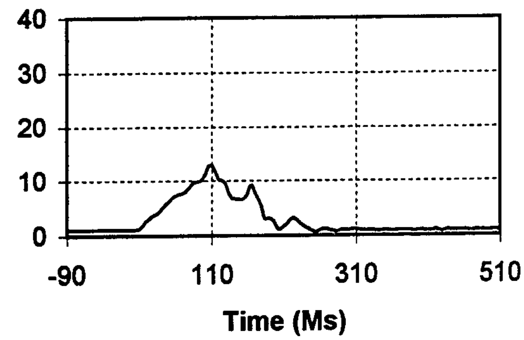


DRI Study Test: 5630 Test Date: 951031 Subj: V-3 Cell: C

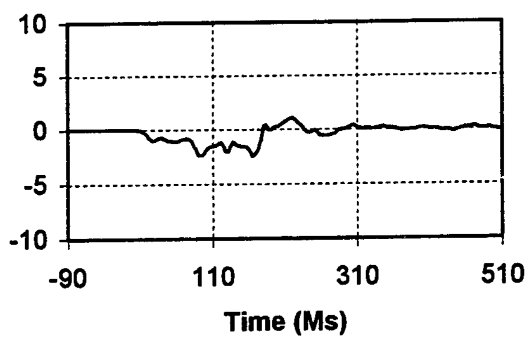
CHEST X ACCEL (G)



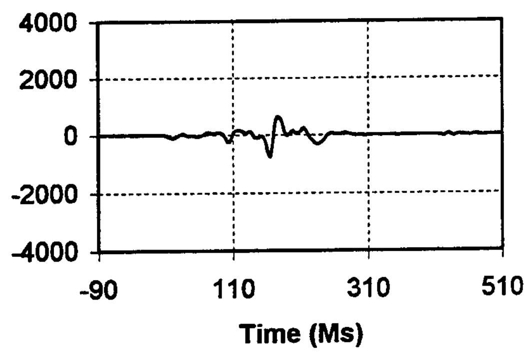
CHEST RESULTANT (G)



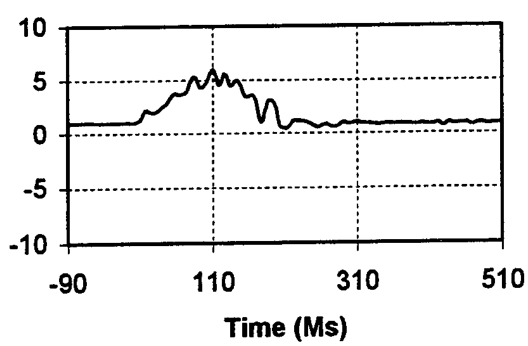
CHEST Y ACCEL (G)



CHEST Ry ANG ACCEL (RAD/SEC2)

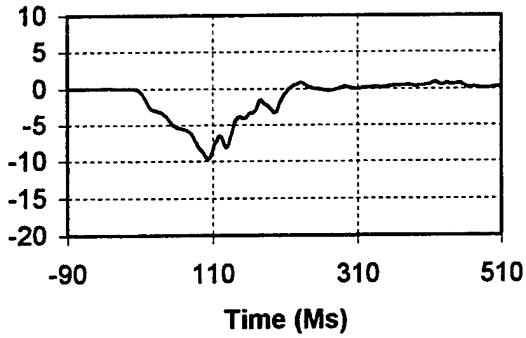


CHEST Z ACCEL (G)

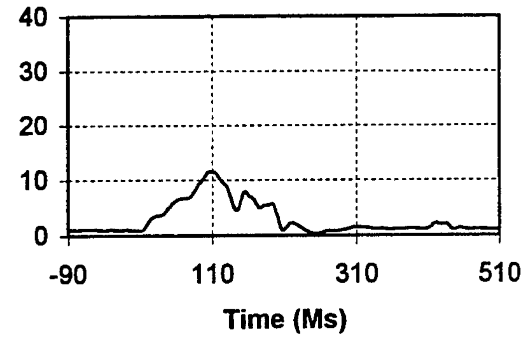


DRI Study Test: 5630 Test Date: 951031 Subj: V-3 Cell: C

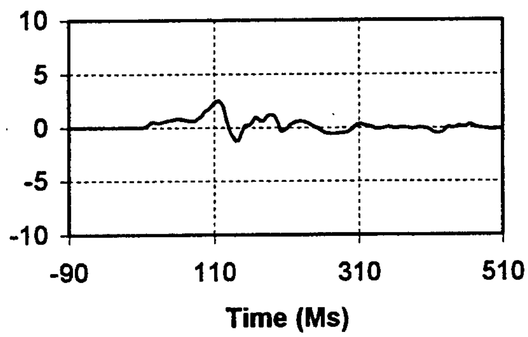
T1 X ACCEL (G)



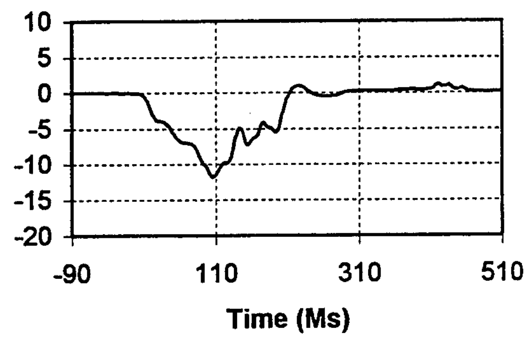
T1 RESULTANT (G)



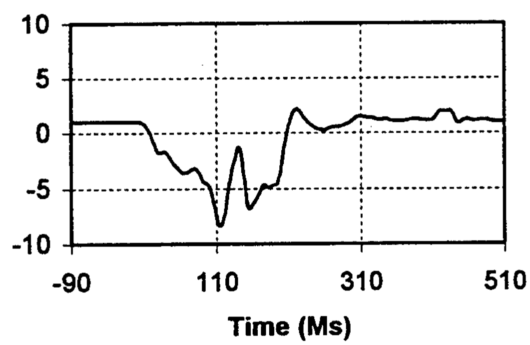
T1 Y ACCEL (G)



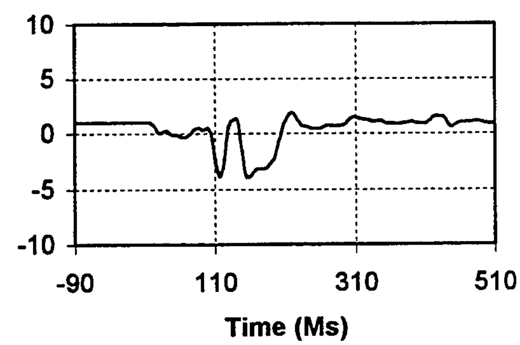
CORRECTED T1 X ACCEL (G)



T1 Z ACCEL (G)



CORRECTED T1 Z ACCEL (G)



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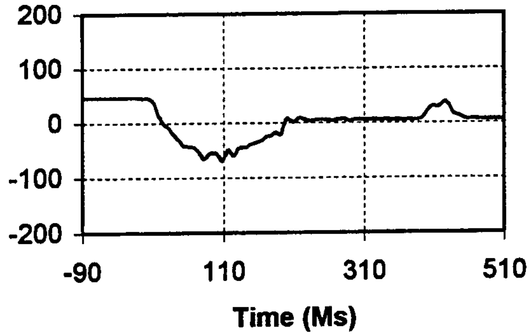
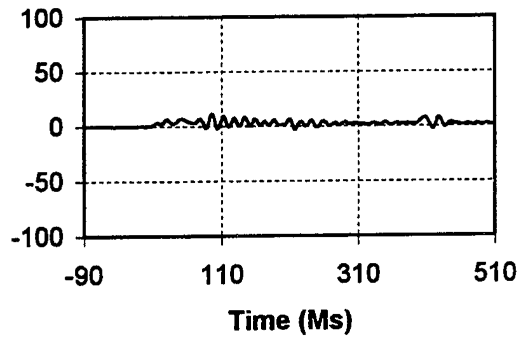
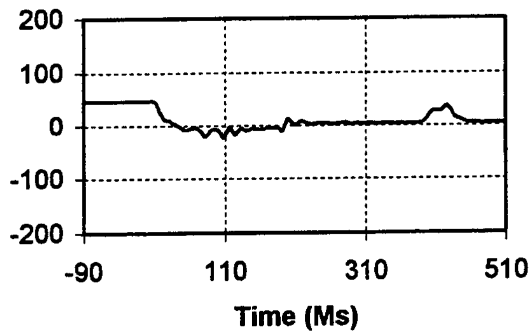
HEADREST X FORCE (LB)



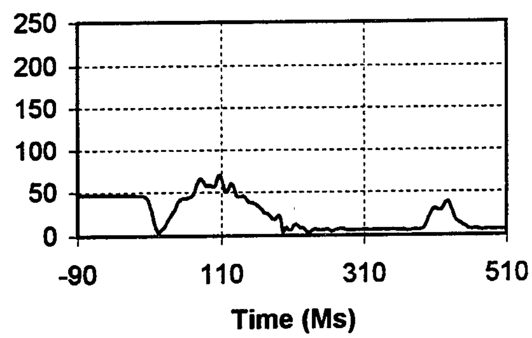
HEADREST Z FORCE (LB)



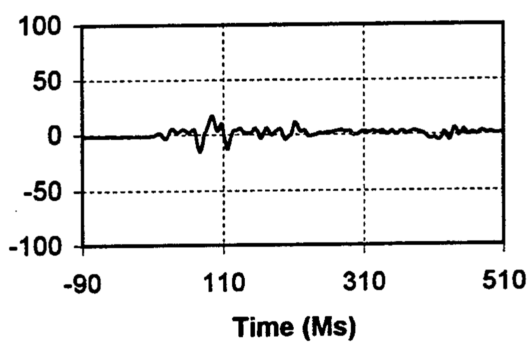
HEADREST X MINUS TARE (LB)



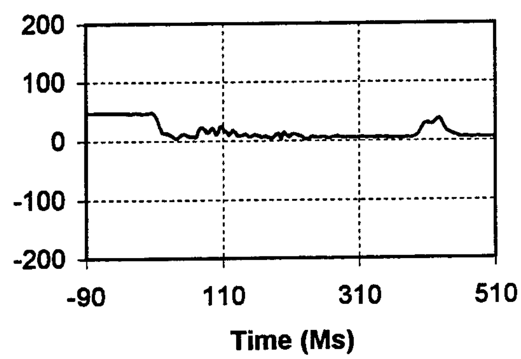
HEADREST RESULTANT (LB)

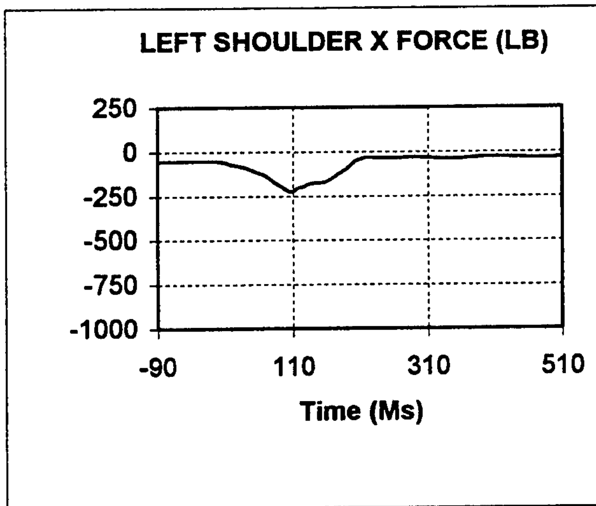


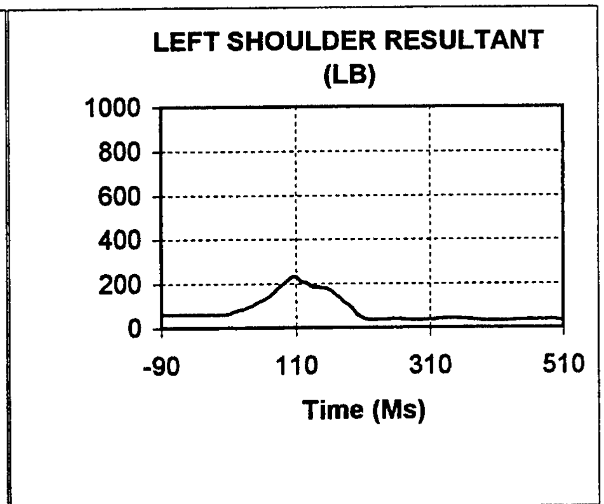
HEADREST Y FORCE (LB)

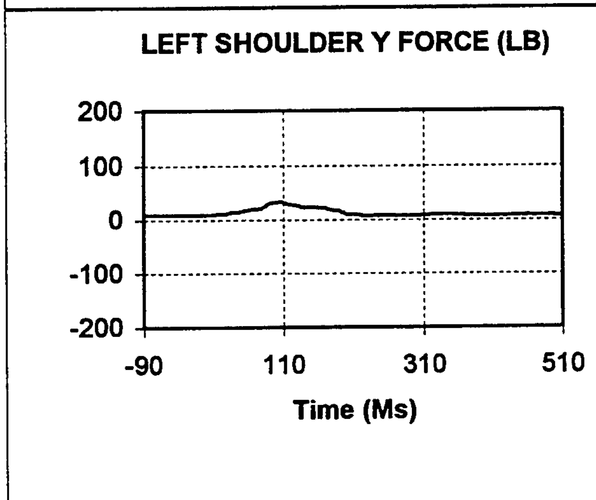


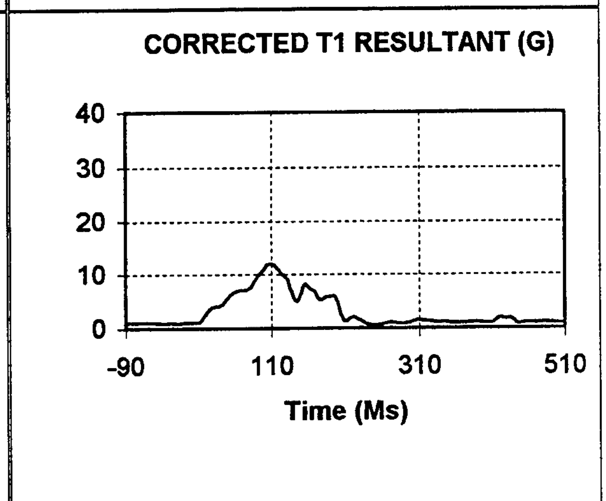
HEADREST RES MINUS TARE (LB)

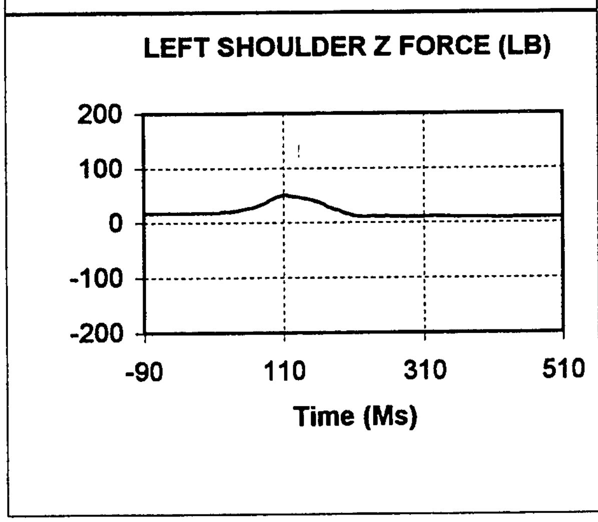


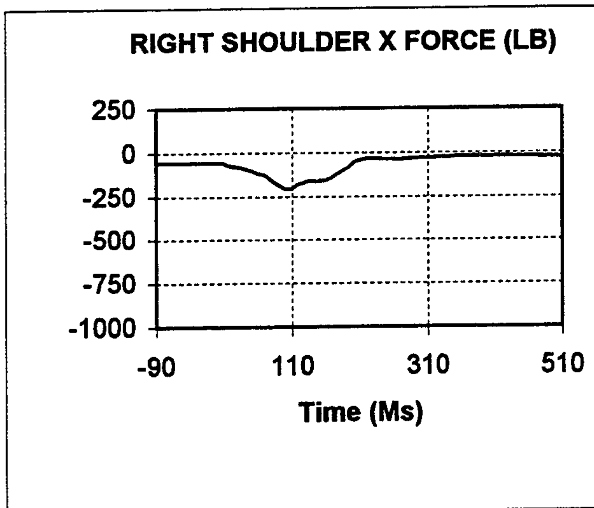

LEFT SHOULDER X FORCE (LB)
250
0
-250
-500
-750
-1000
-90
110
310
510
Time (Ms)

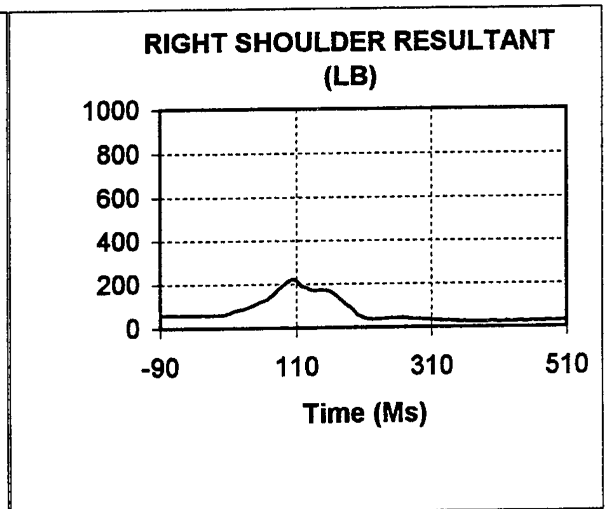

LEFT SHOULDER RESULTANT (LB)
1000
800
600
400
200
0
-90
110
310
510
Time (Ms)

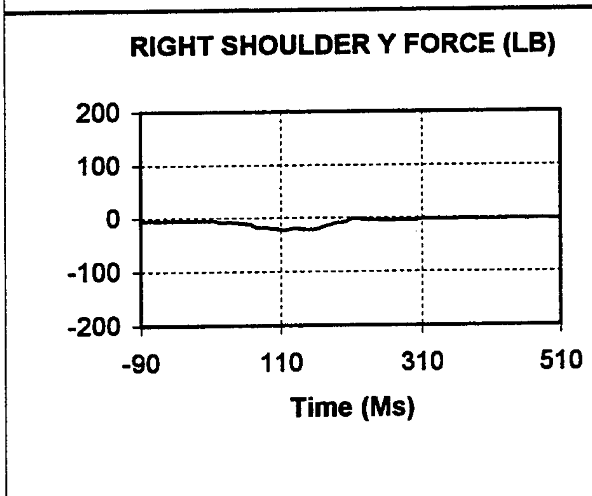

LEFT SHOULDER Y FORCE (LB)
200
100
0
-100
-200
-90
110
310
510
Time (Ms)

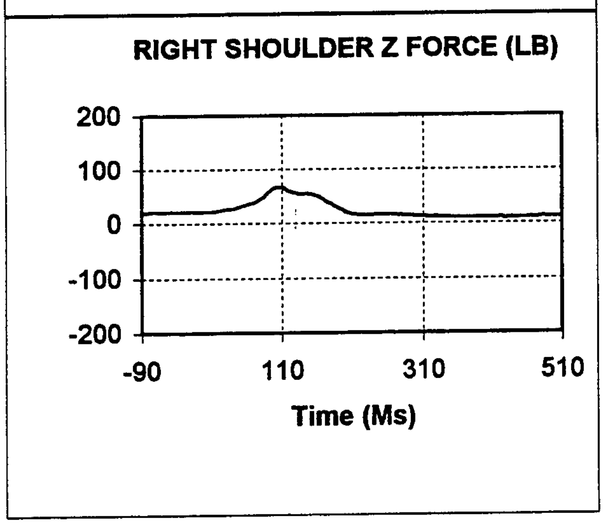

CORRECTED T1 RESULTANT (G)
40
30
20
10
0
-90
110
310
510
Time (Ms)

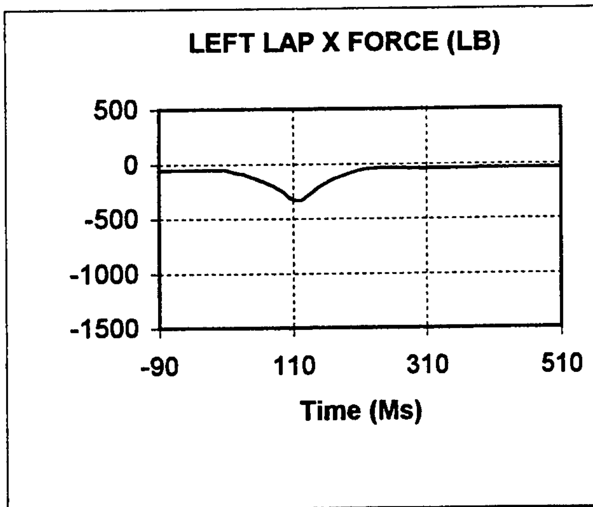

LEFT SHOULDER Z FORCE (LB)
200
100
0
-100
-200
-90
110
310
510
Time (Ms)

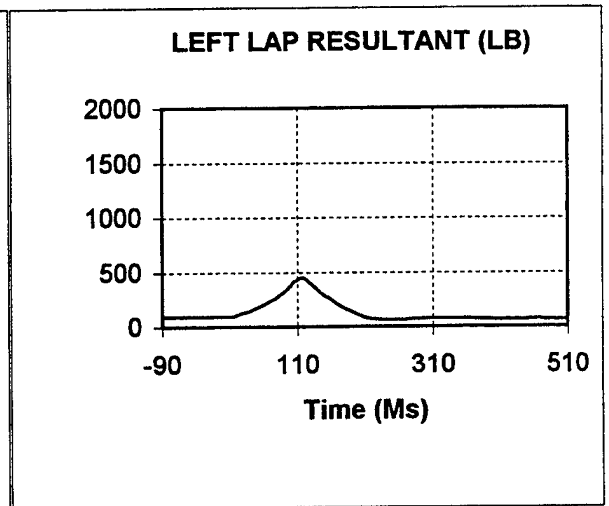

RIGHT SHOULDER X FORCE (LB)
250
0
-250
-500
-750
-1000
-90
110
310
510
Time (Ms)

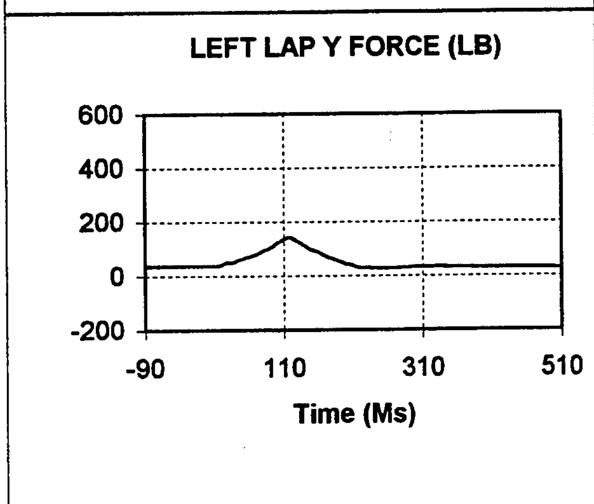

RIGHT SHOULDER RESULTANT (LB)
1000
800
600
400
200
0
-90
110
310
510
Time (Ms)

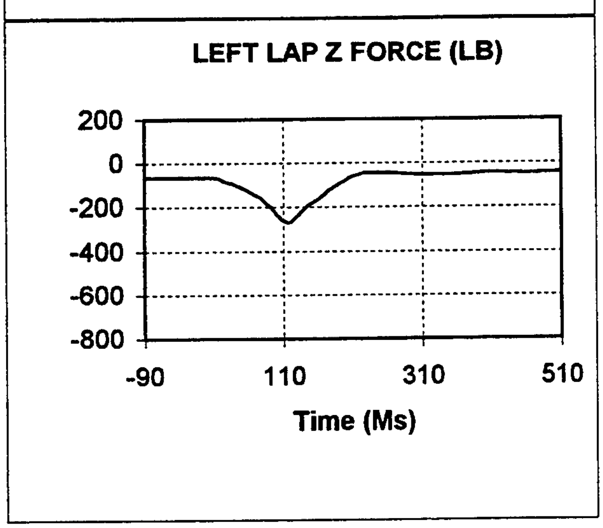

RIGHT SHOULDER Y FORCE (LB)
200
100
0
-100
-200
-90
110
310
510
Time (Ms)


RIGHT SHOULDER Z FORCE (LB)
200
100
0
-100
-200
-90
110
310
510
Time (Ms)

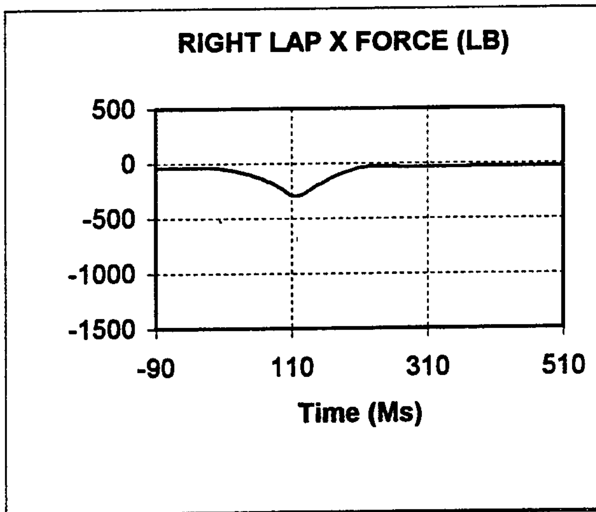

LEFT LAP X FORCE (LB)
500
0
-500
-1000
-1500
-90
110
310
510
Time (Ms)

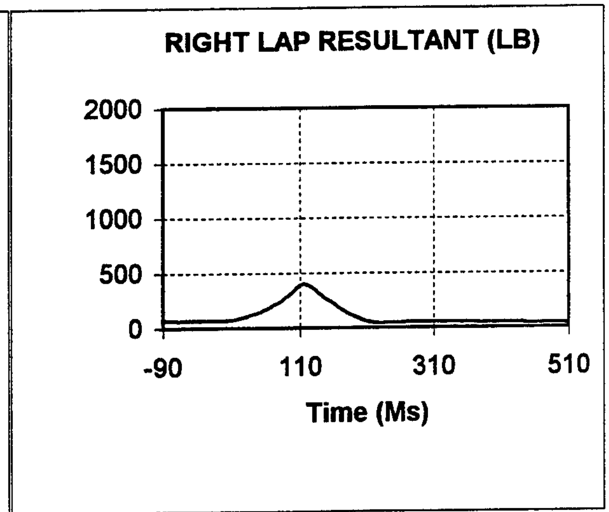

LEFT LAP RESULTANT (LB)
2000
1500
1000
500
0
-90
110
310
510
Time (Ms)

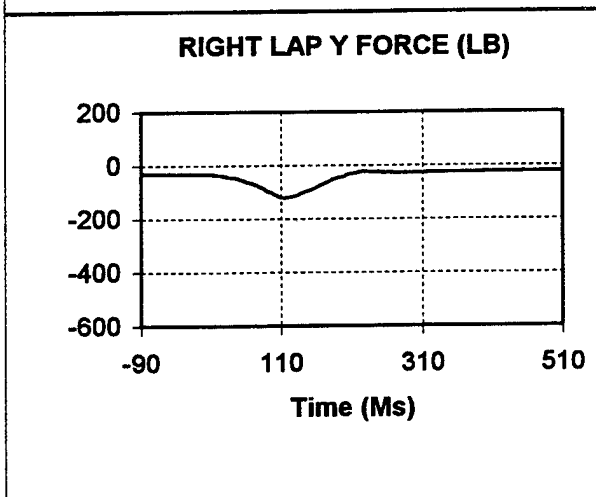

LEFT LAP Y FORCE (LB)
600
400
200
0
-200
-90
110
310
510
Time (Ms)

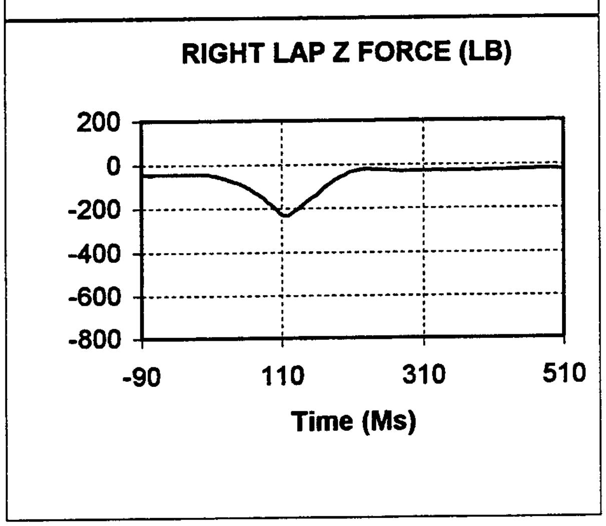

LEFT LAP Z FORCE (LB)
200
0
-200
-400
-600
-800
-90
110
310
510
Time (Ms)

DRI Study Test: 5630 Test Date: 951031 Subj: V-3 Cell: C









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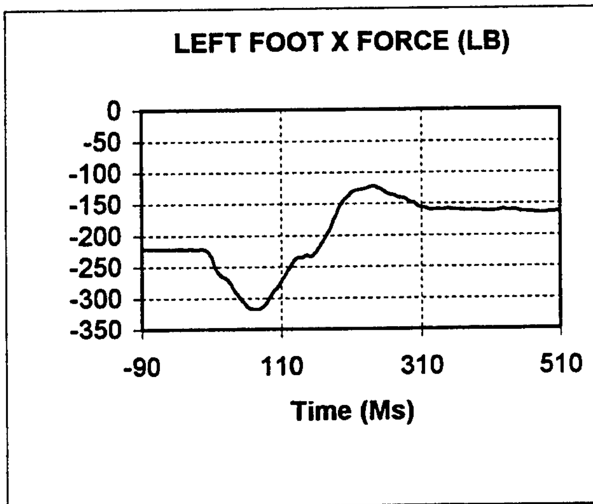
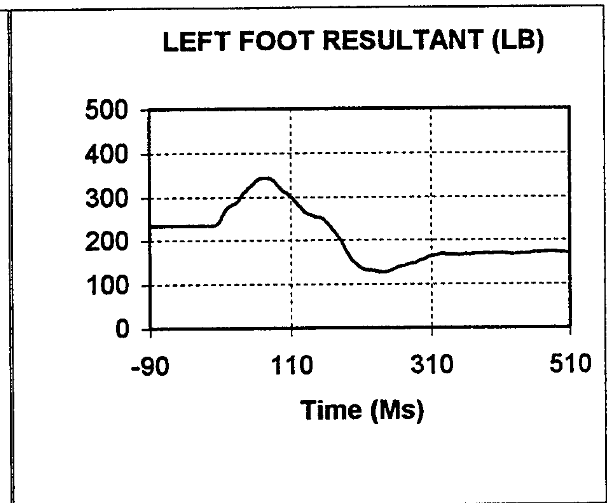
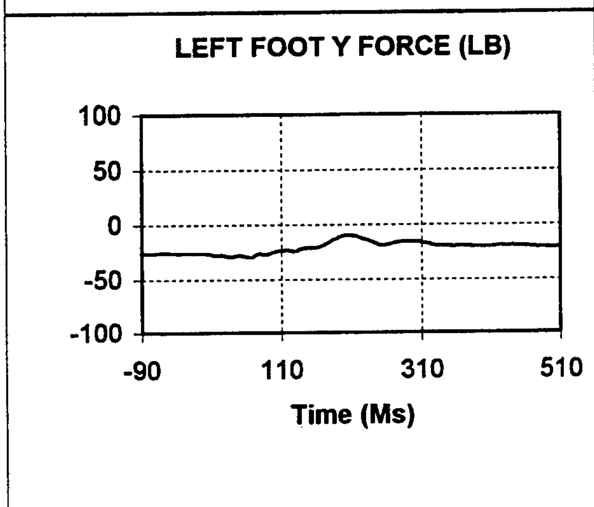
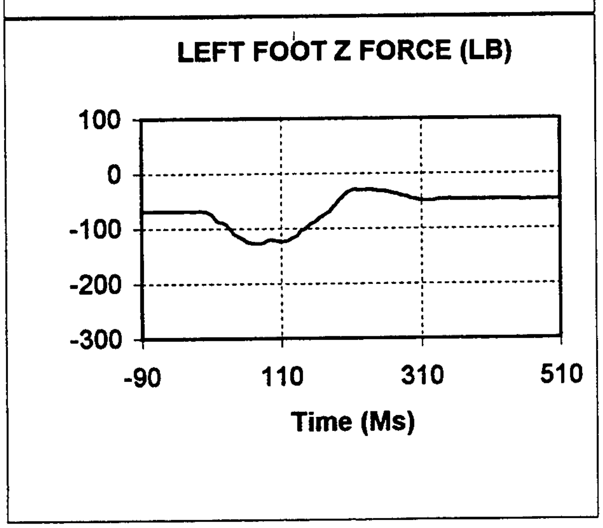
DRI Study Test: 5630 Test Date: 951031 Subj: V-3 Cell: C









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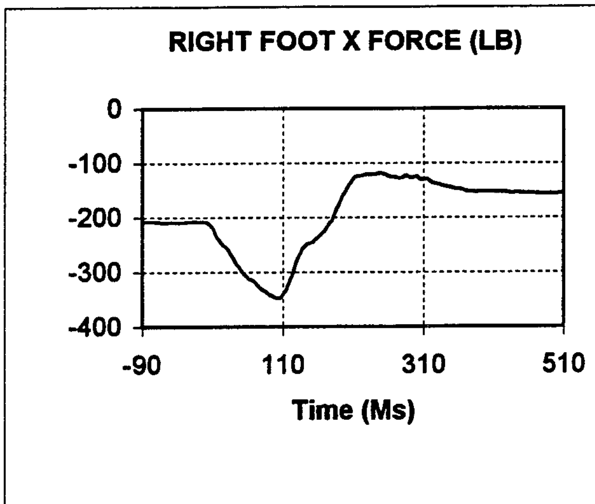
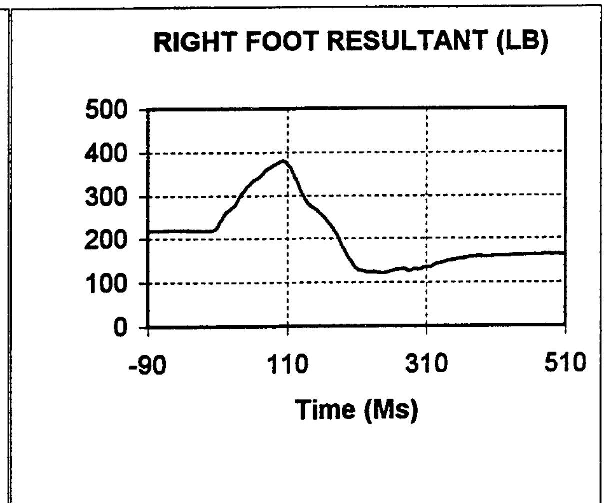
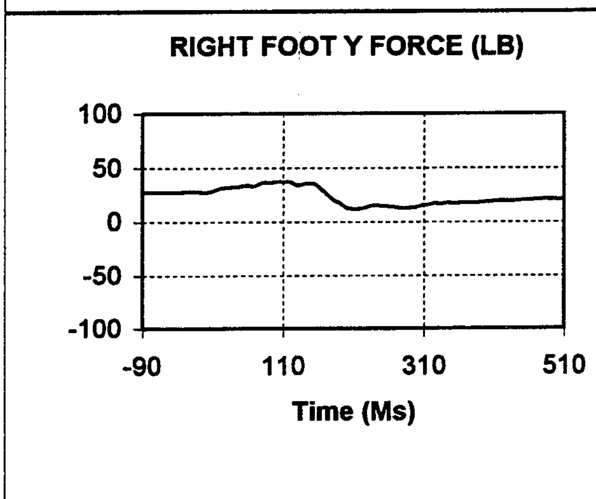
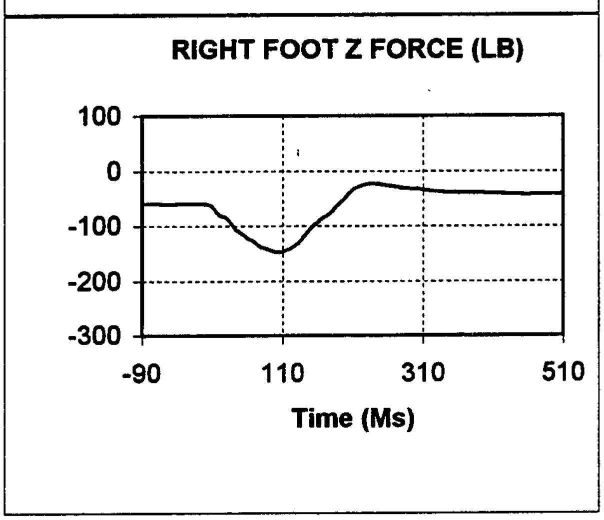
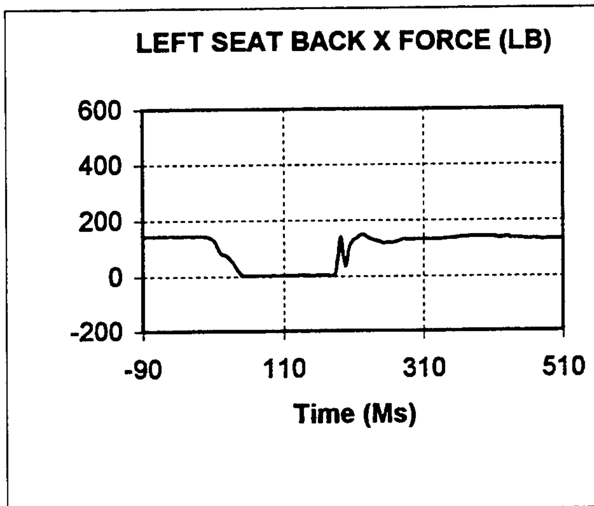

RIGHT FOOT X FORCE (LB)
0
-100
-200
-300
-400
-90
110
310
510
Time (Ms)

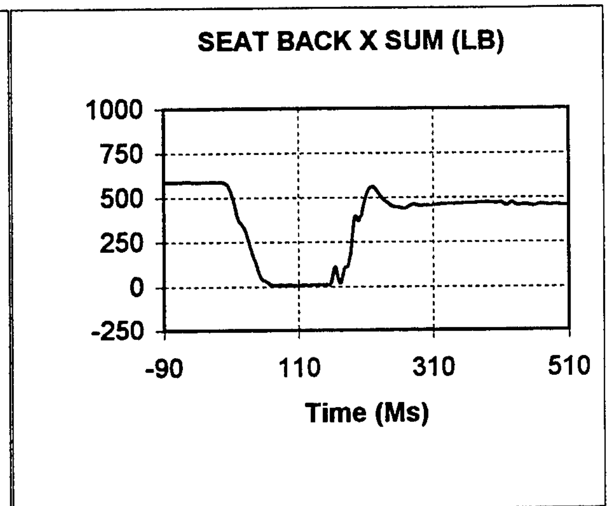

RIGHT FOOT RESULTANT (LB)
500
400
300
200
100
0
-90
110
310
510
Time (Ms)

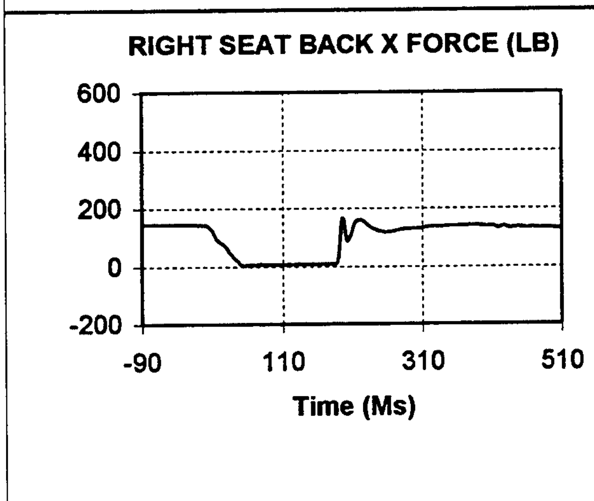

RIGHT FOOT Y FORCE (LB)
100
50
0
-50
-100
-90
110
310
510
Time (Ms)

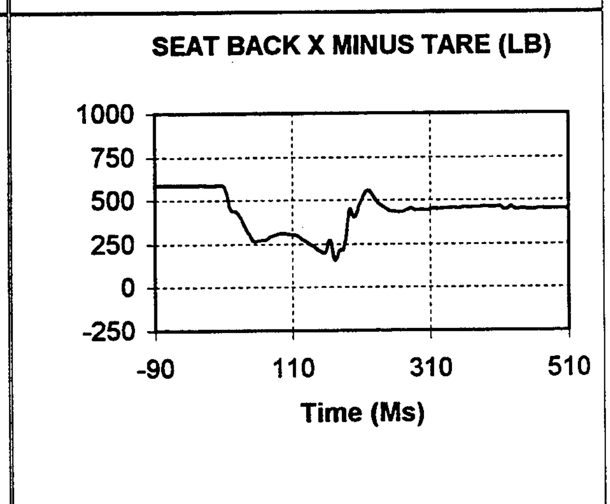

RIGHT FOOT Z FORCE (LB)
100
0
-100
-200
-300
-90
110
310
510
Time (Ms)

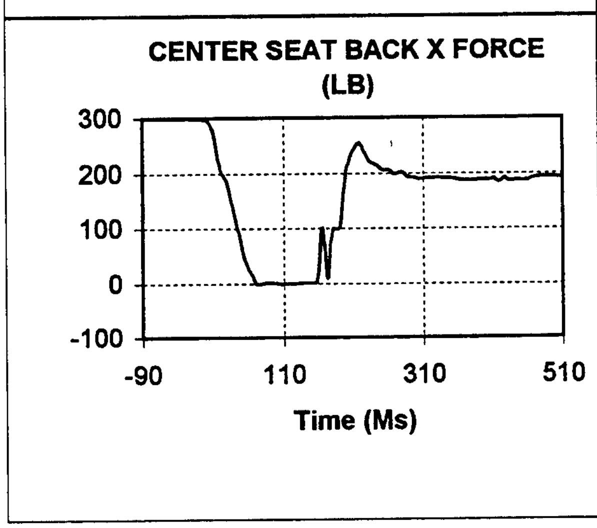
DRI Study Test: 5630 Test Date: 951031 Subj: V-3 Cell: C



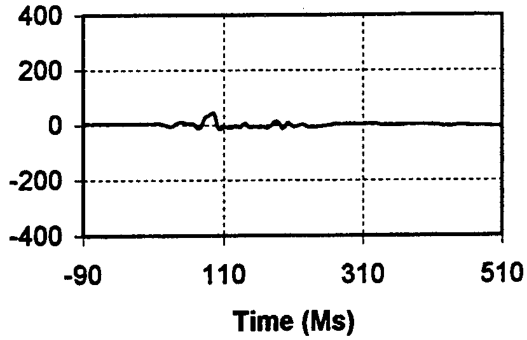




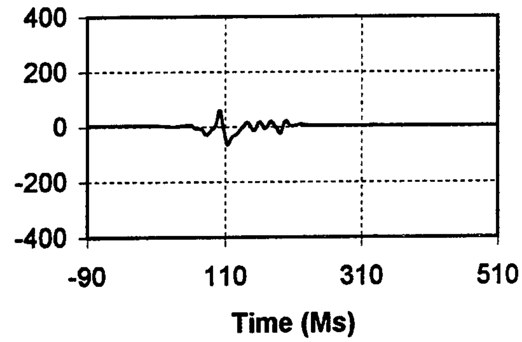




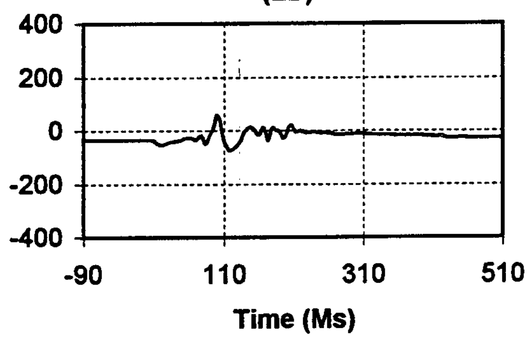
TOP SEAT BACK Y FORCE (LB)



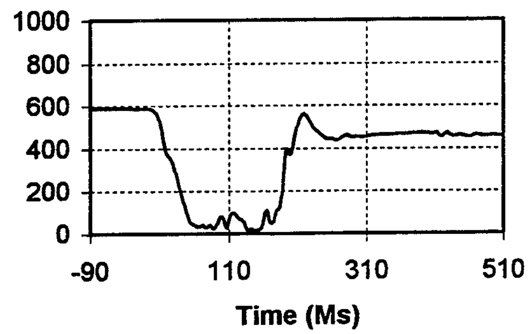
SEAT BACK Z FORCE (LB)



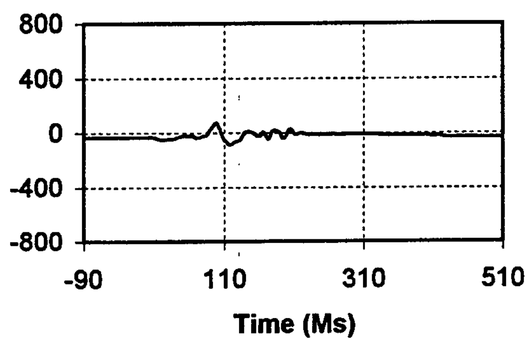
BOTTOM SEAT BACK Y FORCE (LB)



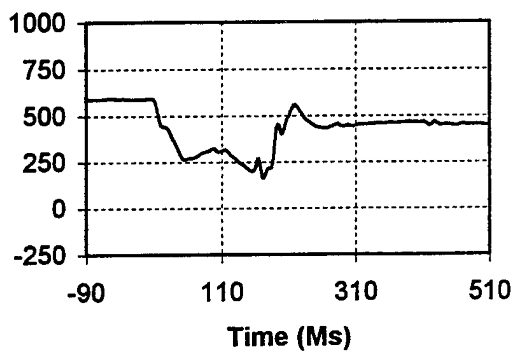
SEAT BACK RESULTANT (LB)



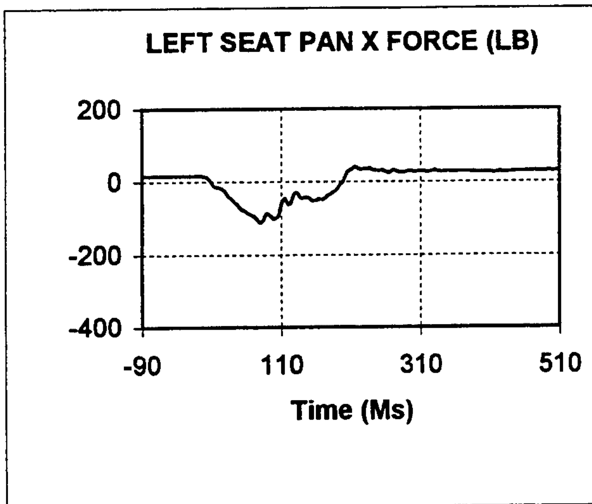
SEAT BACK Y SUM (LB)

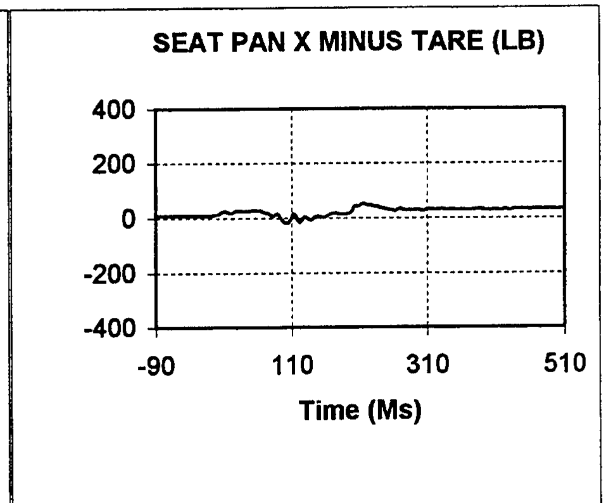


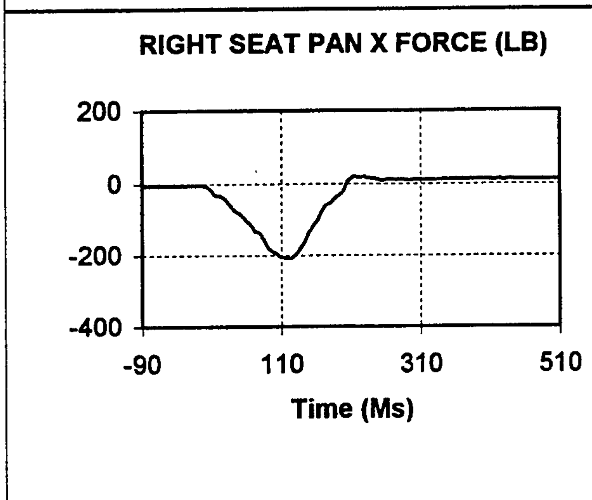
SEAT BACK RES MINUS TARE (LB)

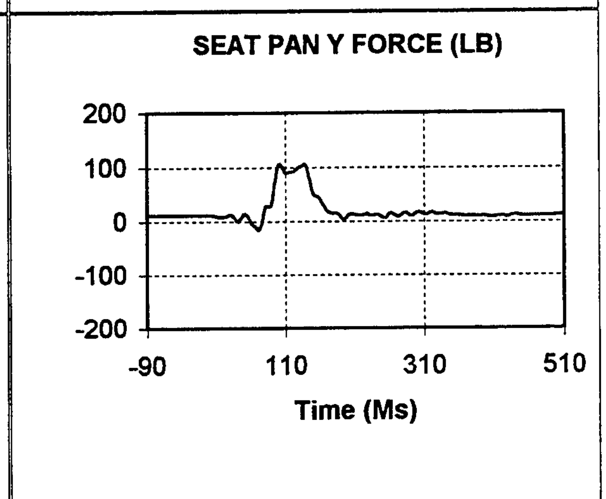


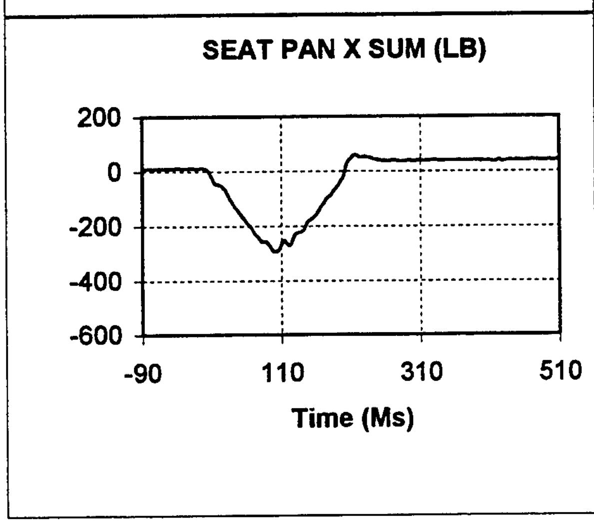
DRI Study Test: 5630 Test Date: 951031 Subj: V-3 Cell: C











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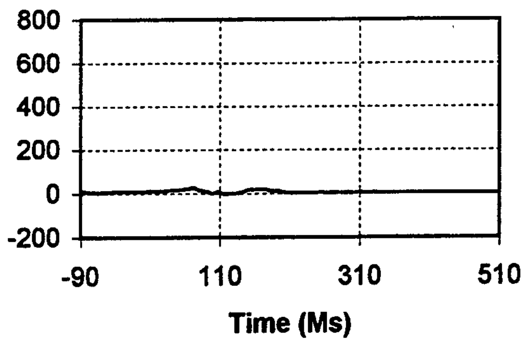
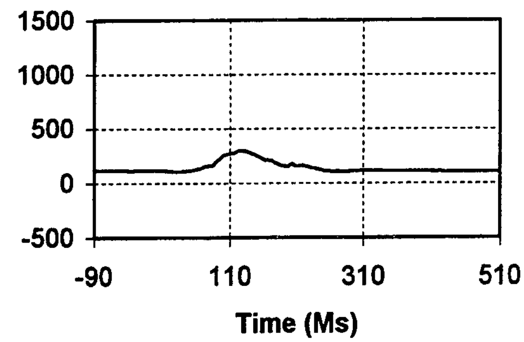
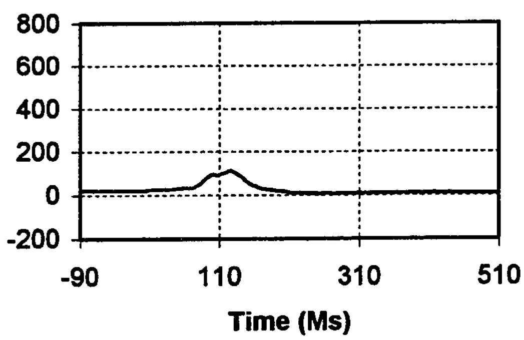
LEFT SEAT PAN Z FORCE (LB)



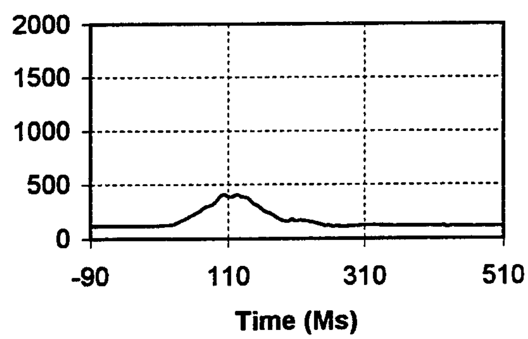
SEAT PAN Z SUM (LB)



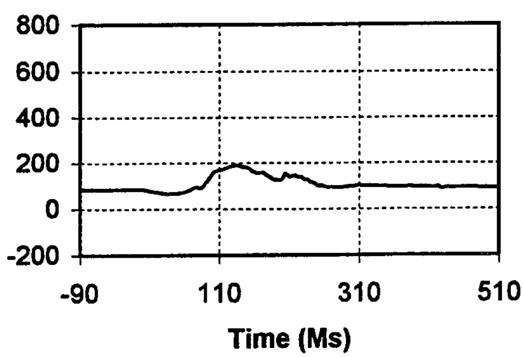
RIGHT SEAT PAN Z FORCE (LB)



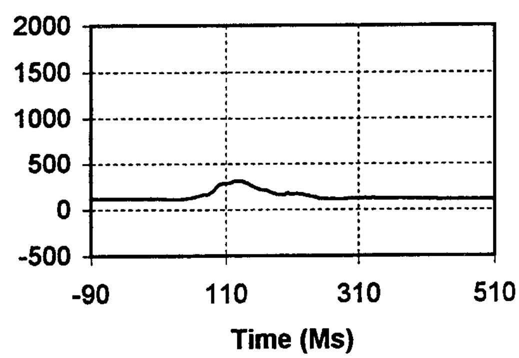
SEAT PAN RESULTANT (LB)



CENTER SEAT PAN Z FORCE (LB)



SEAT PAN RES MINUS TARE (LB)



DRI Study Test: 5631 Test Date: 951031 Subj: C-13 Wt: 200.0
Nom G: 10.0 Cell: C 60 Hz Filter

Data ID	Immediate Preimpact	Maximum Value	Minimum Value	Time Of Maximum	Time Of Minimum
Reference Mark Time (Ms)				-89.0	
Impact Rise Time (Ms)				99.0	
Impact Duration (Ms)				206.0	
Velocity Change (Ft/Sec)		39.52			
Sled Acceleration (G)					
X Axis	0.04	9.91	-0.38	99.0	301.0
Y Axis	0.00	0.43	-0.54	63.0	73.0
Z Axis	1.00	1.21	0.23	258.0	75.0
Sled Velocity (Ft/Sec)	0.05	40.35	0.10	210.0	0.0
Seat Pan Acceleration (G)					
X Axis	-0.03	0.54	-9.64	210.0	101.0
Y Axis	0.00	1.64	-1.84	96.0	227.0
Head Acceleration (G)					
X Axis	-0.04	4.50	-10.38	335.0	117.0
Y Axis	-0.09	1.54	-1.99	382.0	347.0
Z Axis	0.93	7.63	-5.19	225.0	339.0
Resultant	0.94	10.97	0.27	115.0	304.0
Ry (Rad/Sec2)	3.68	571.77	-464.53	339.0	225.0
Chest Acceleration (G)					
X Axis	-0.03	4.17	-9.96	233.0	97.0
Y Axis	-0.02	1.22	-2.95	231.0	99.0
Z Axis	1.00	6.64	-0.17	136.0	229.0
Resultant	1.00	11.88	0.24	116.0	252.0
Ry (Rad/Sec2)	-0.58	228.88	-312.14	213.0	226.0
T1 Acceleration (G)					
X Axis	0.03	2.19	-11.03	221.0	111.0
Y Axis	0.04	1.85	-0.96	108.0	226.0
Z Axis	1.00	4.99	-5.14	230.0	126.0
Resultant	1.00	11.96	0.72	111.0	282.0
T1 Corrected Acceleration (G)					
X Axis	0.02	3.75	-12.21	231.0	111.0
Z Axis	0.99	6.06	-1.73	140.0	180.0
Resultant	0.99	12.45	0.79	111.0	322.0

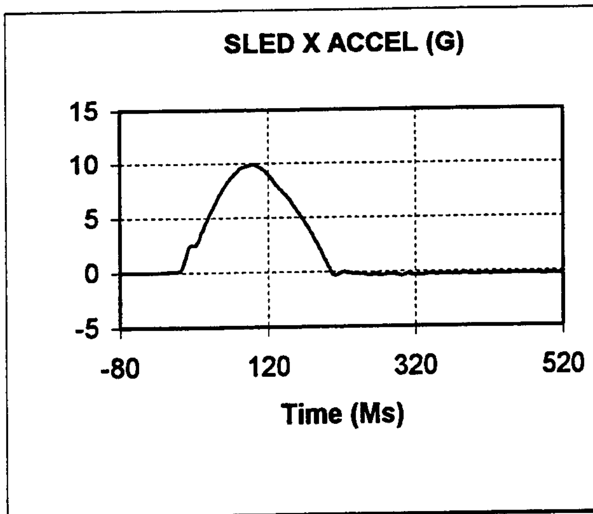
DRI Study Test: 5631 Test Date: 951031 Subj: C-13 Wt: 200.0
Nom G: 10.0 Cell: C 60 Hz Filter

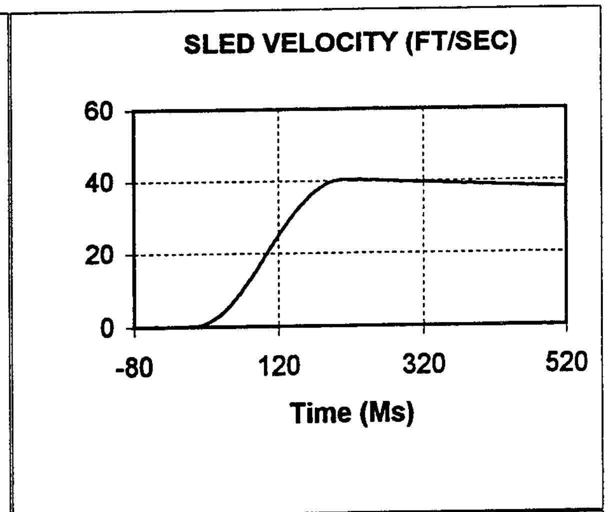
Data ID	Immediate Preimpact	Maximum Value	Minimum Value	Time Of Maximum	Time Of Minimum
Headrest Force (Lb)					
X Axis	72.81	71.86	-65.63	340.0	111.0
X Axis Minus Tare	72.99	72.99	-19.87	5.0	77.0
Y Axis	-4.07	19.14	-19.70	223.0	341.0
Z Axis	-1.35	17.29	-19.64	228.0	236.0
Resultant	72.94	74.72	1.83	341.0	256.0
Resultant Minus Tare	73.12	73.83	0.77	341.0	256.0
Left Shoulder Force (Lb)					
X Axis	-48.08	-2.60	-227.89	328.0	112.0
Y Axis	0.27	15.45	-3.28	97.0	242.0
Z Axis	-11.53	0.38	-30.72	323.0	90.0
Resultant	49.44	229.99	2.63	112.0	328.0
Right Shoulder Force (Lb)					
X Axis	-60.86	-10.30	-230.90	468.0	113.0
Y Axis	-6.07	0.42	-35.13	222.0	115.0
Z Axis	-10.89	-0.25	-16.97	223.0	75.0
Resultant	62.13	233.68	10.52	113.0	468.0
Left Lap Force (Lb)					
X Axis	-112.52	-40.89	-571.65	510.0	120.0
Y Axis	33.84	102.01	15.10	117.0	241.0
Z Axis	-121.80	-39.36	-412.98	510.0	119.0
Resultant	169.24	712.51	59.10	120.0	510.0
Right Lap Force (Lb)					
X Axis	-88.55	-34.81	-540.31	500.0	121.0
Y Axis	-23.96	-5.64	-81.48	501.0	126.0
Z Axis	-79.10	-14.42	-348.70	511.0	120.0
Resultant	121.13	647.85	38.46	121.0	501.0
Left Foot Force (Lb)					
X Axis	-276.14	-106.39	-479.09	220.0	79.0
Y Axis	-20.56	2.67	-25.16	238.0	152.0
Z Axis	-59.70	-19.02	-180.08	225.0	81.0
Resultant	283.27	512.01	108.30	79.0	221.0
Right Foot Force (Lb)					
X Axis	-304.29	-153.08	-547.17	220.0	81.0
Y Axis	26.21	34.05	9.28	76.0	204.0
Z Axis	-40.86	-15.43	-181.39	223.0	79.0
Resultant	308.13	577.25	154.40	81.0	220.0

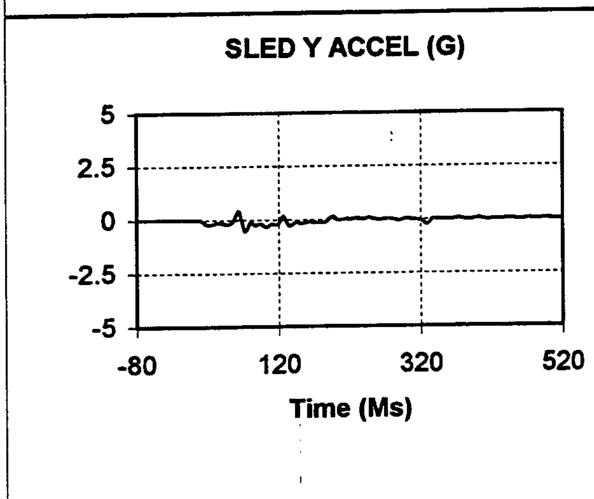
DRI Study Test: 5631 Test Date: 951031 Subj: C-13 Wt: 200.0
Nom G: 10.0 Cell: C 60 Hz Filter

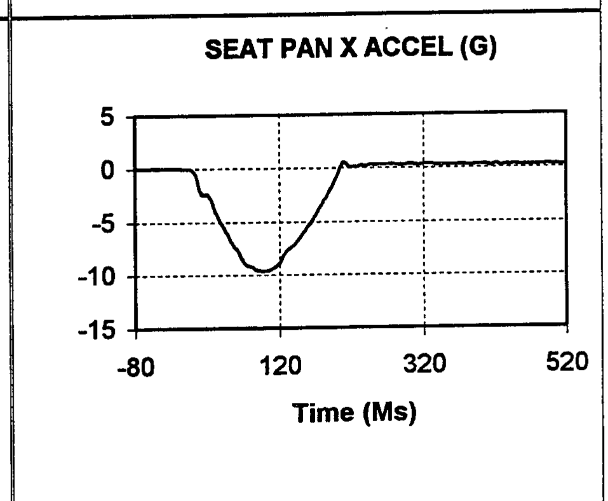
Data ID	Immediate Preimpact	Maximum Value	Minimum Value	Time Of Maximum	Time Of Minimum
Seat Back Force (Lb)					
Left X Axis	306.41	377.69	-0.68	231.0	56.0
Right X Axis	255.86	315.23	2.35	227.0	55.0
Center X Axis	150.07	354.65	-57.06	219.0	229.0
X Axis Sum	712.35	890.10	-0.77	220.0	56.0
X Axis Minus Tare	713.46	888.97	88.77	220.0	187.0
Top Y Axis	14.76	64.80	-63.51	95.0	132.0
Bottom Y Axis	-3.71	81.80	-212.63	106.0	88.0
Y Axis Sum	11.05	93.48	-233.65	112.0	87.0
Z Axis	-0.50	50.29	-90.49	157.0	80.0
Resultant	712.44	890.84	23.94	220.0	181.0
Resultant Minus Tare	713.54	889.70	92.36	220.0	187.0
Seat Pan Force (Lb)					
Left X Axis	12.66	58.48	-108.15	227.0	78.0
Right X Axis	1.55	42.49	-235.49	235.0	122.0
X Axis Sum	14.20	88.82	-311.12	226.0	92.0
X Axis Minus Tare	15.22	87.37	-57.20	226.0	130.0
Y Axis	-3.96	136.54	-3.83	132.0	1.0
Left Z Axis	19.70	103.98	-1.81	131.0	236.0
Right Z Axis	26.80	250.31	16.45	125.0	511.0
Center Z Axis	127.39	479.66	116.74	133.0	511.0
Z Axis Sum	173.90	822.37	146.30	131.0	496.0
Resultant	174.52	880.24	148.07	130.0	495.0
Resultant Minus Tare	174.61	835.55	147.02	131.0	495.0

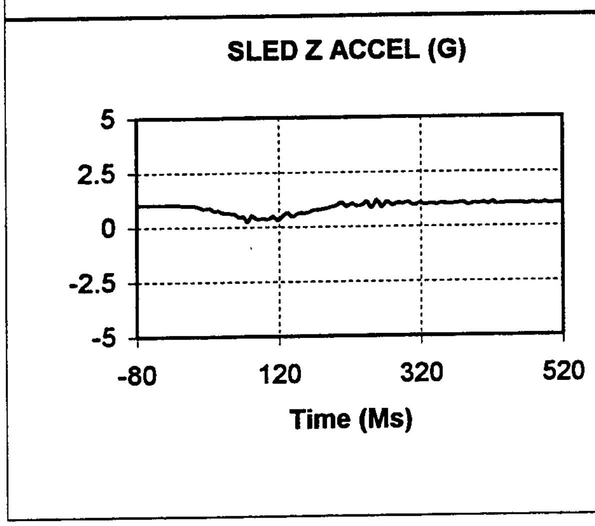
DRI Study Test: 5631 Test Date: 951031 Subj: C-13 Cell: C

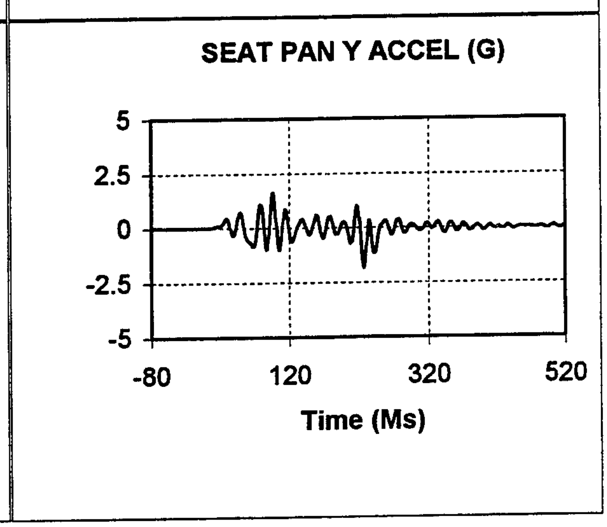




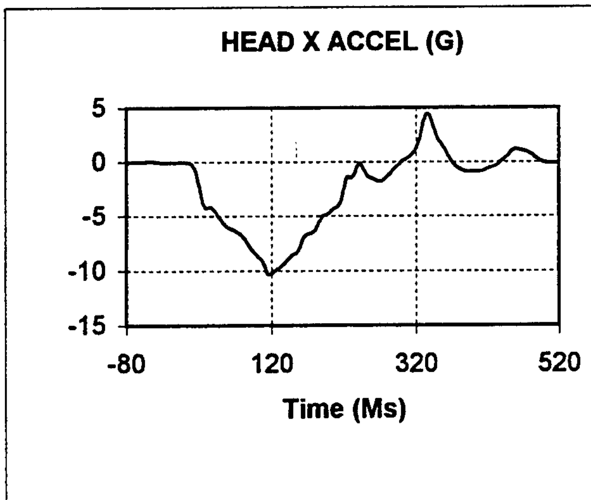


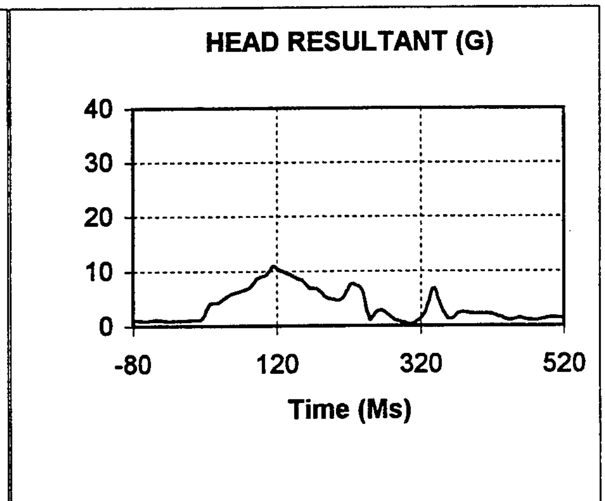


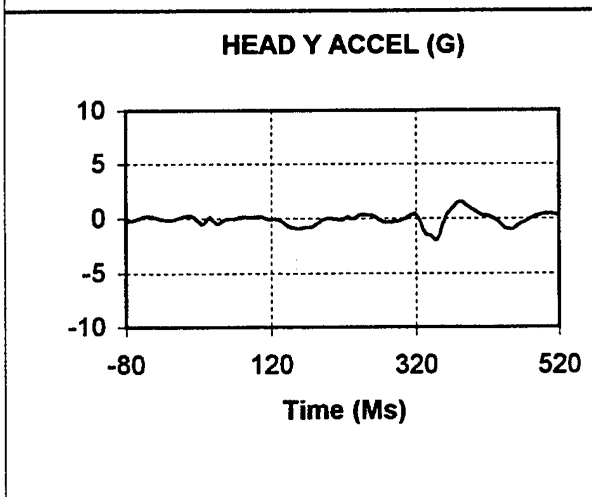


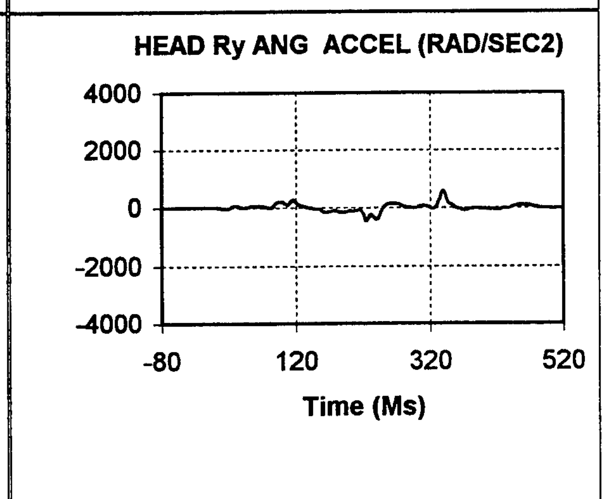


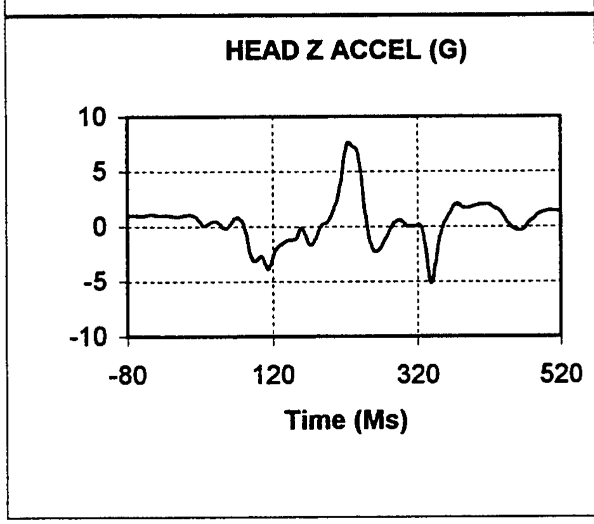
DRI Study Test: 5631 Test Date: 951031 Subj: C-13 Cell: C



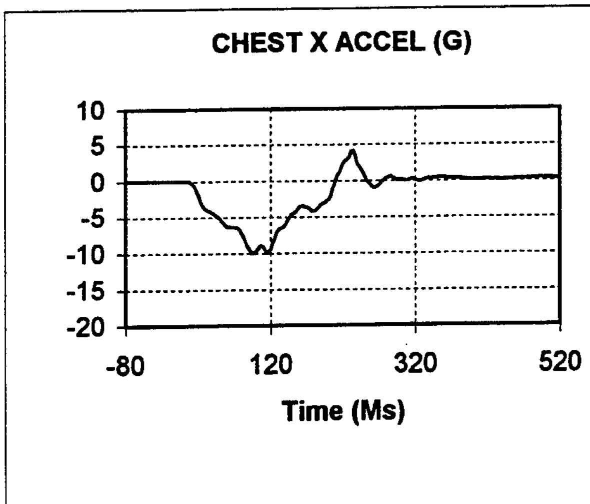


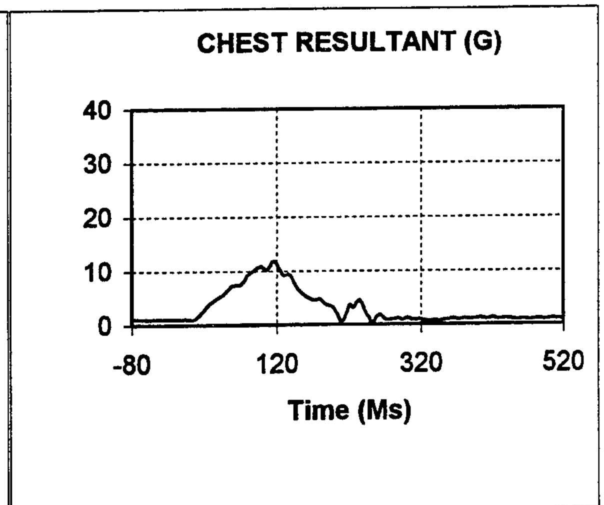


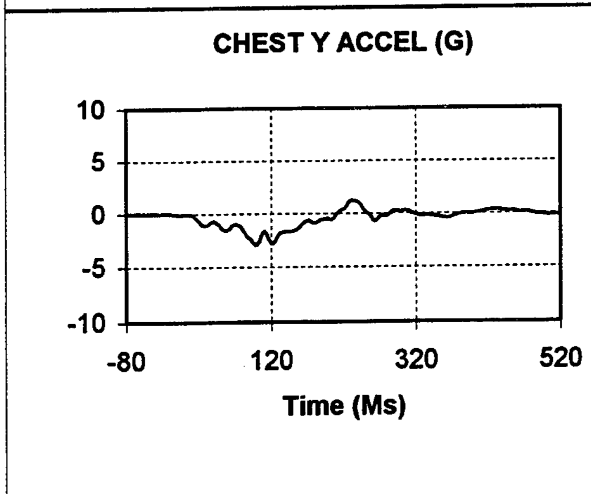


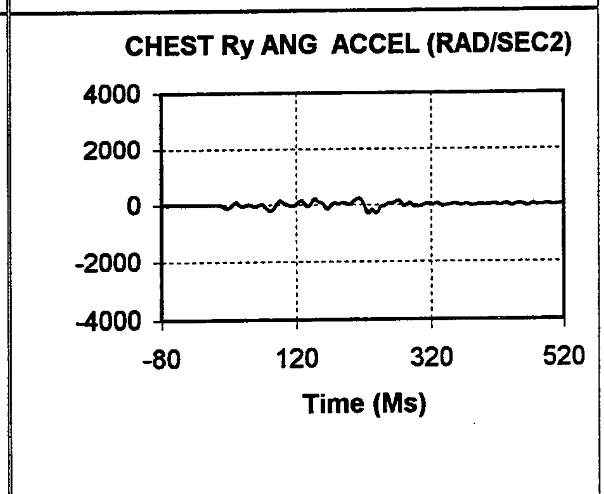


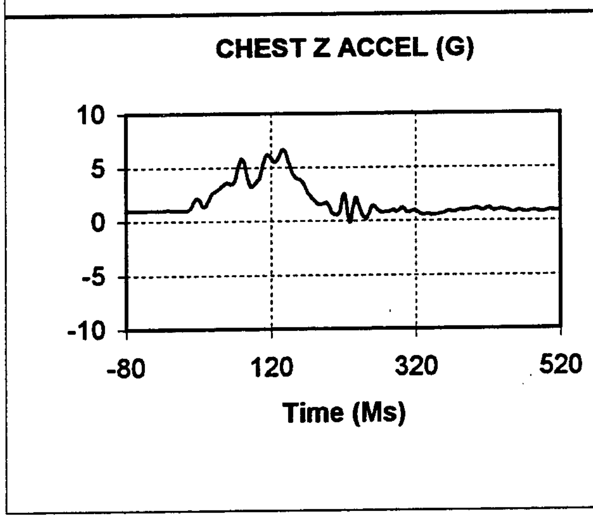
DRI Study Test: 5631 Test Date: 951031 Subj: C-13 Cell: C



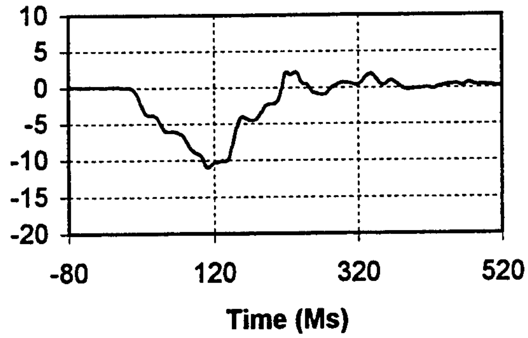




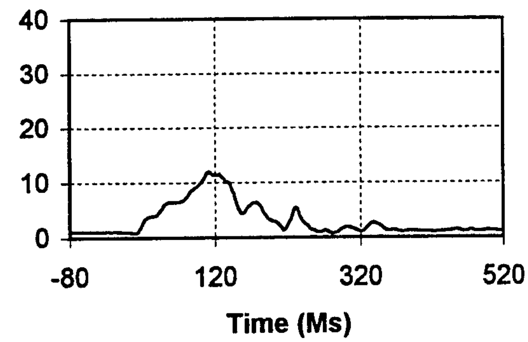




T1 X ACCEL (G)



T1 RESULTANT (G)



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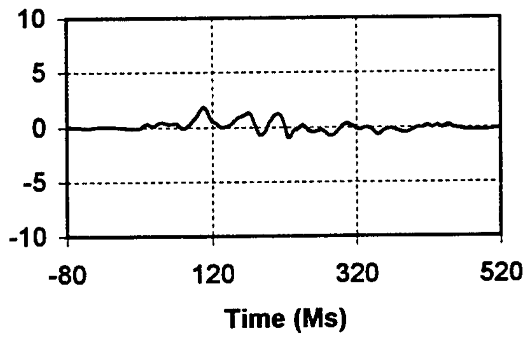
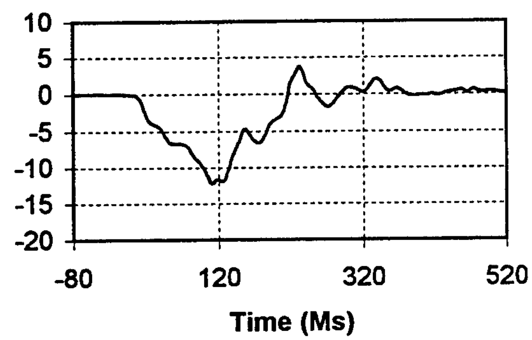
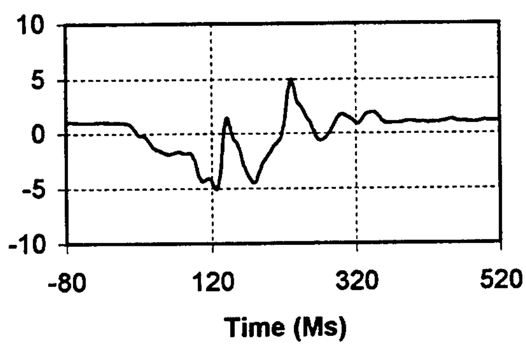


CORRECTED T1 X ACCEL (G)



T1 Z ACCEL (G)



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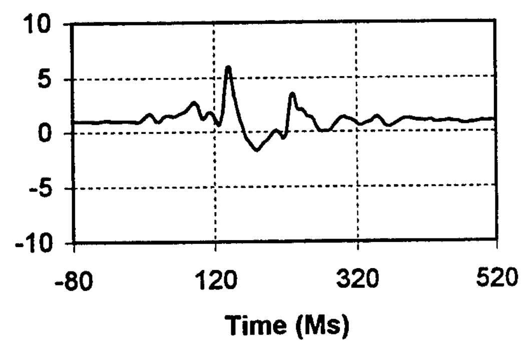
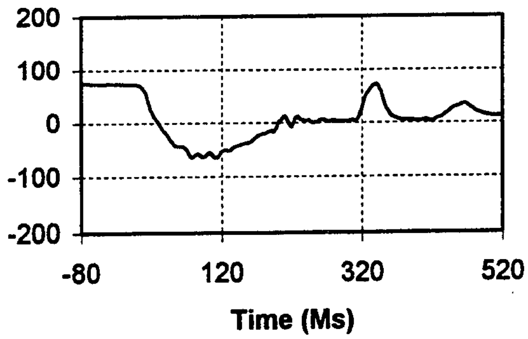
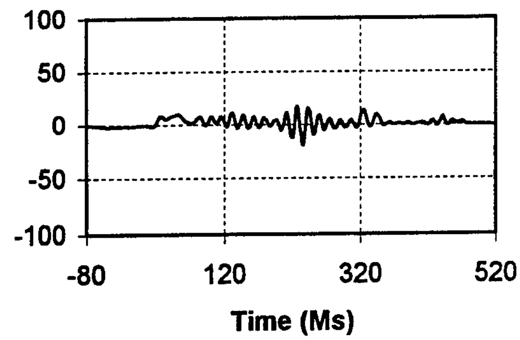


DRI Study Test: 5631 Test Date: 951031 Subj: C-13 Cell: C

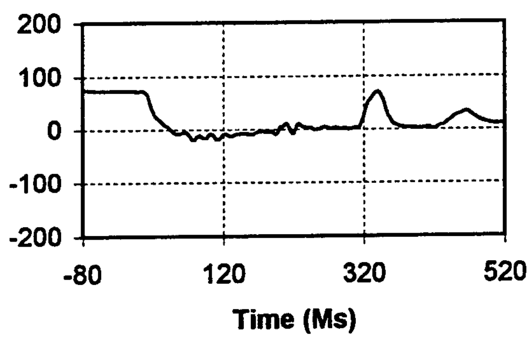
HEADREST X FORCE (LB)



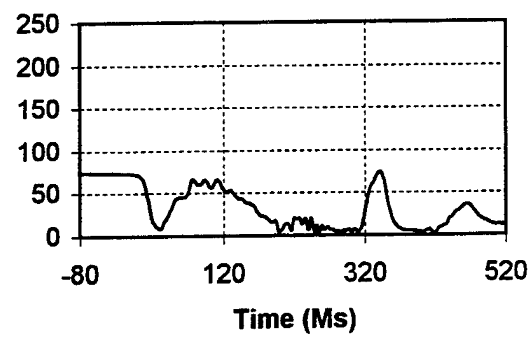
HEADREST Z FORCE (LB)



HEADREST X MINUS TARE (LB)



HEADREST RESULTANT (LB)



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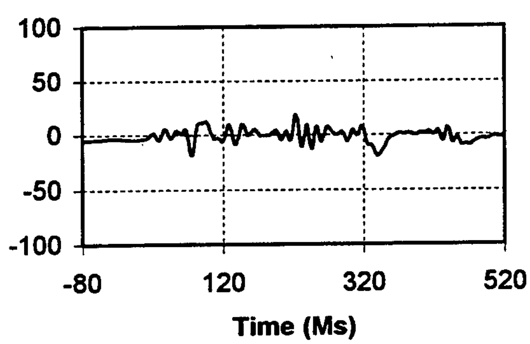
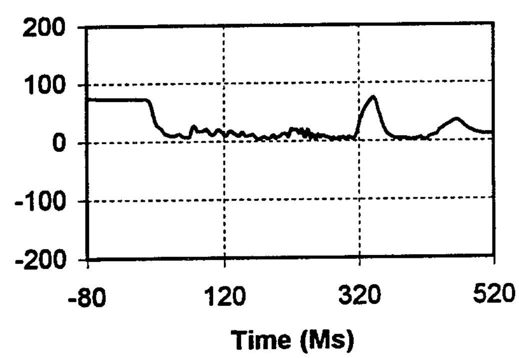
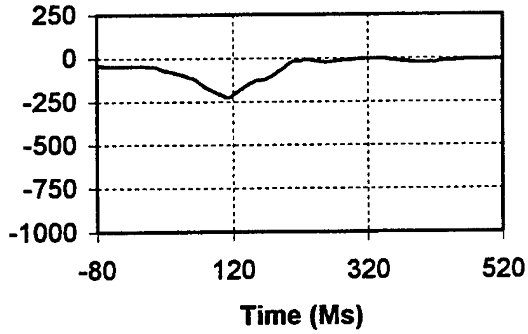


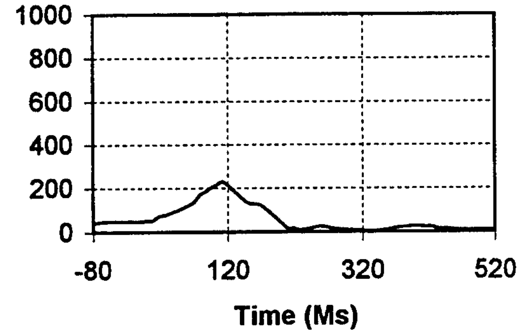
HEADREST RES MINUS TARE (LB)



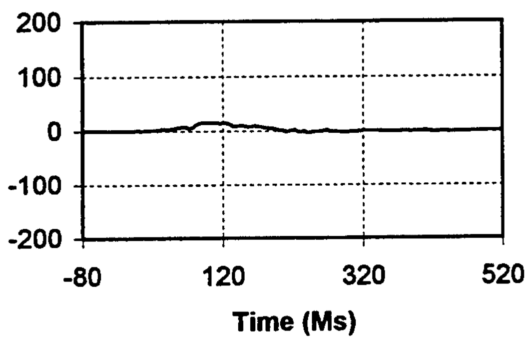
LEFT SHOULDER X FORCE (LB)



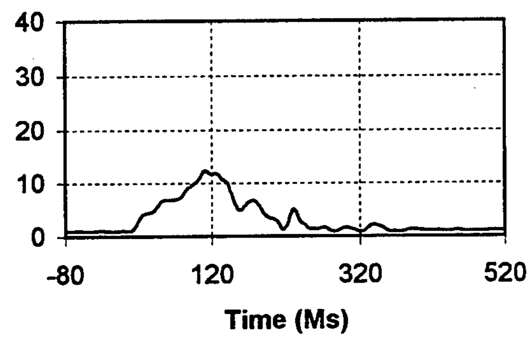
LEFT SHOULDER RESULTANT (LB)



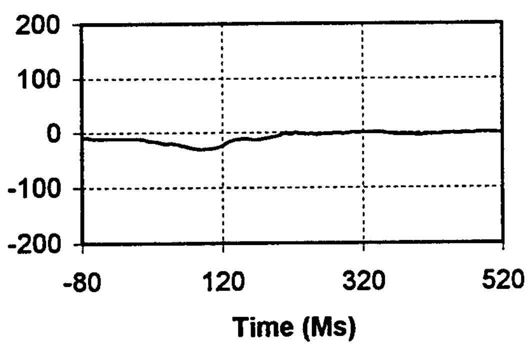
LEFT SHOULDER Y FORCE (LB)



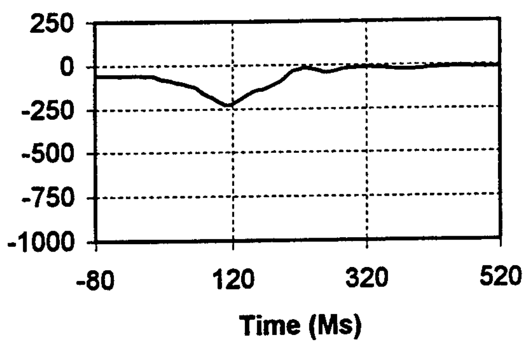
CORRECTED T1 RESULTANT (G)



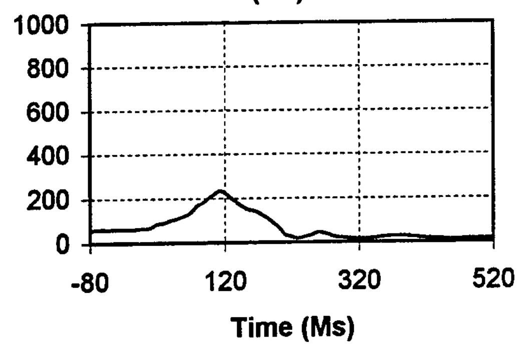
LEFT SHOULDER Z FORCE (LB)



RIGHT SHOULDER X FORCE (LB)



RIGHT SHOULDER RESULTANT (LB)



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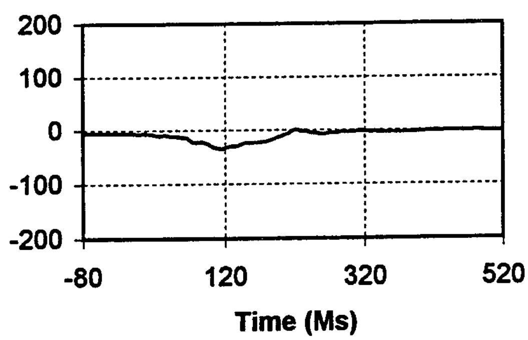
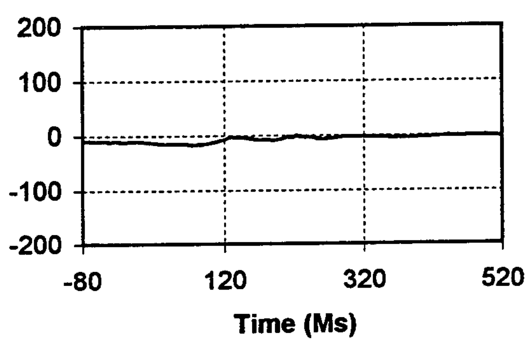
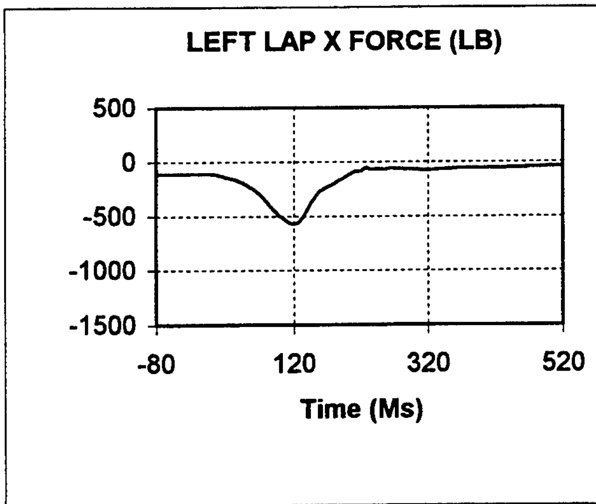
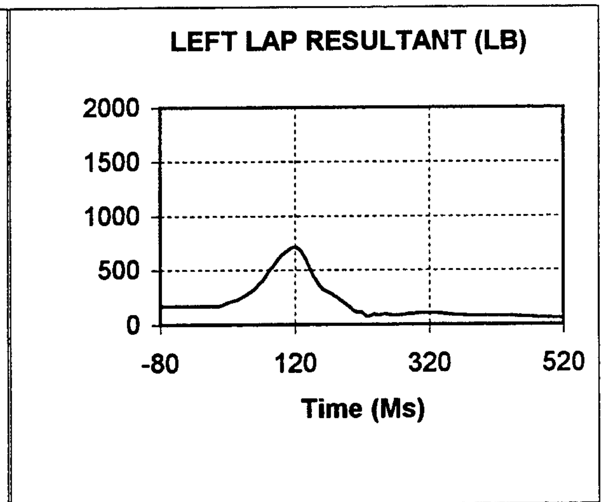


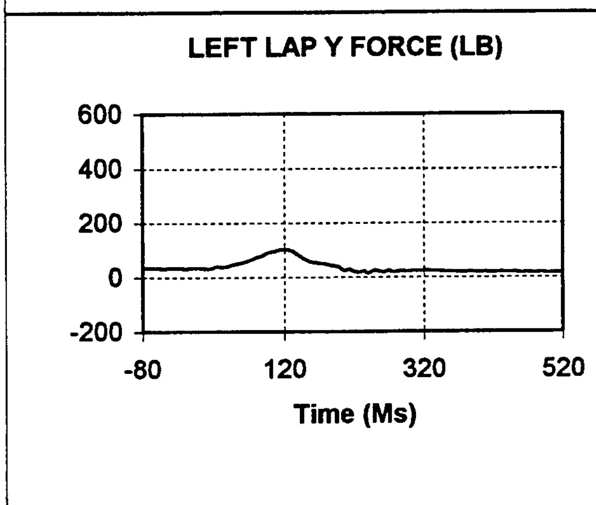
RIGHT SHOULDER Z FORCE (LB)

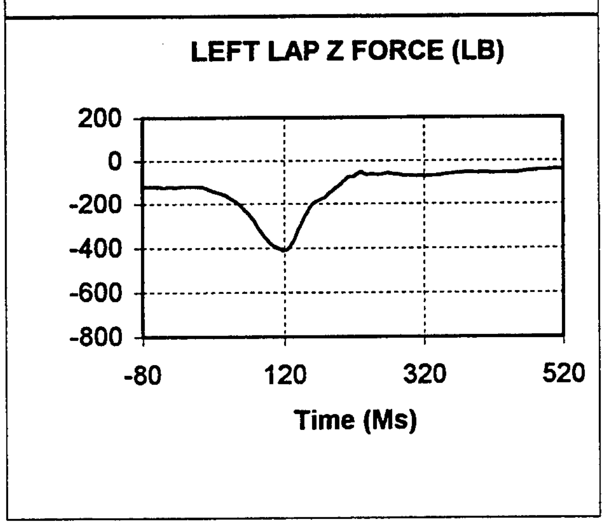


DRI Study Test: 5631 Test Date: 951031 Subj: C-13 Cell: C

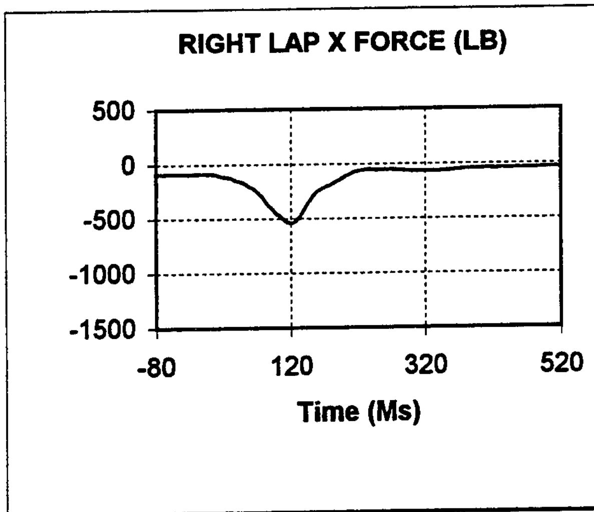


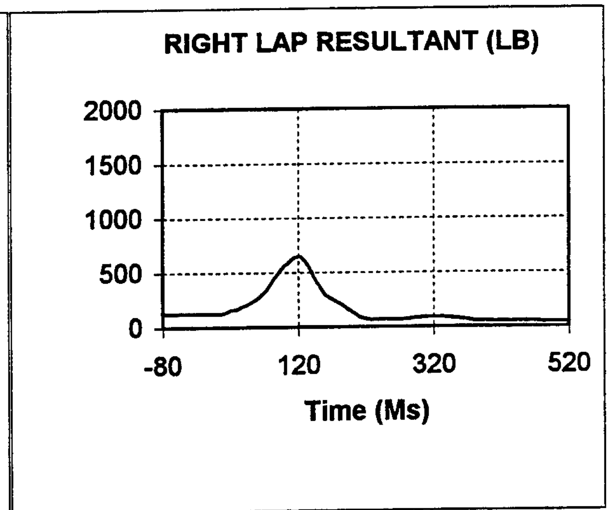


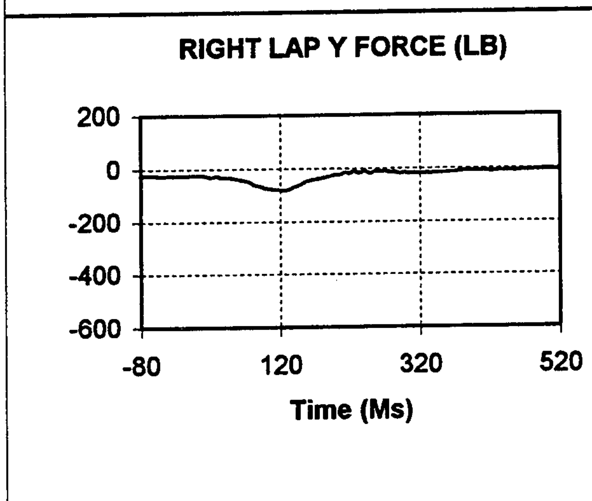


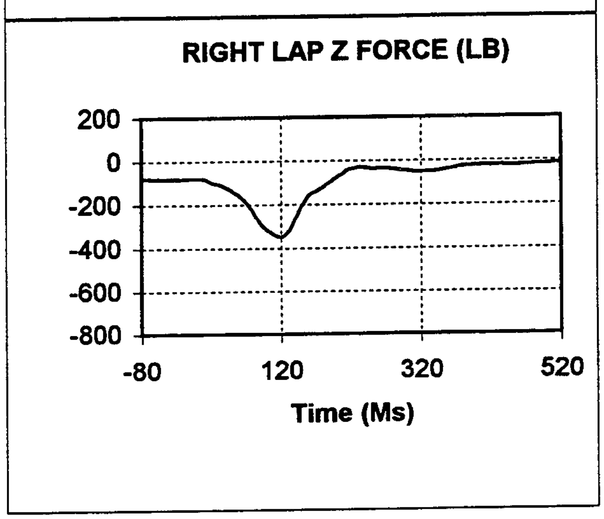


DRI Study Test: 5631 Test Date: 951031 Subj: C-13 Cell: C

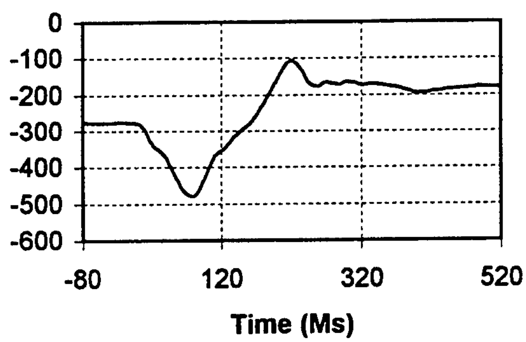




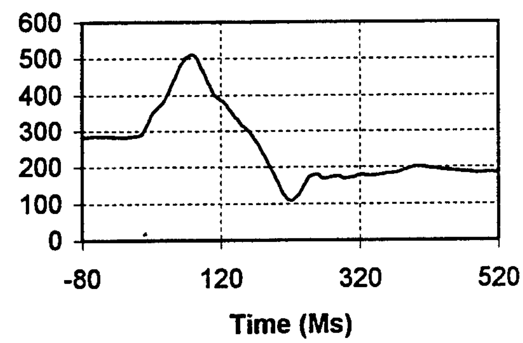




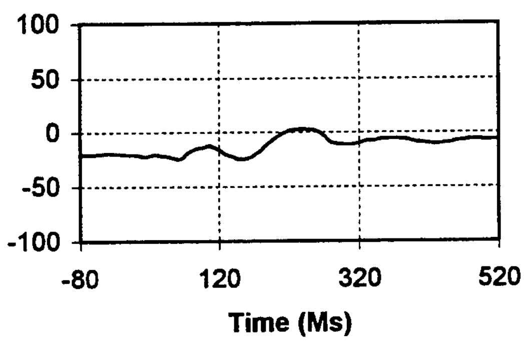
LEFT FOOT X FORCE (LB)



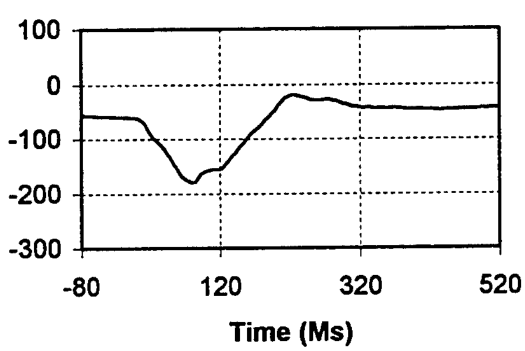
LEFT FOOT RESULTANT (LB)



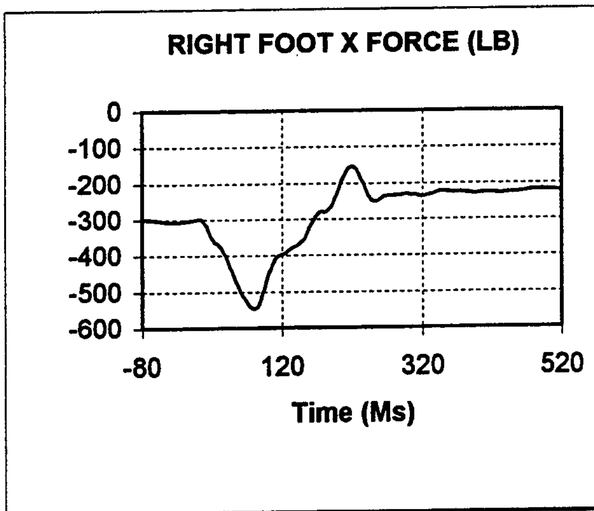
LEFT FOOT Y FORCE (LB)

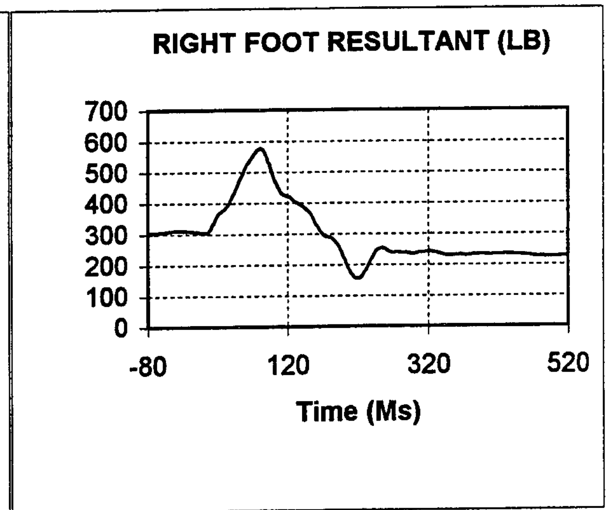


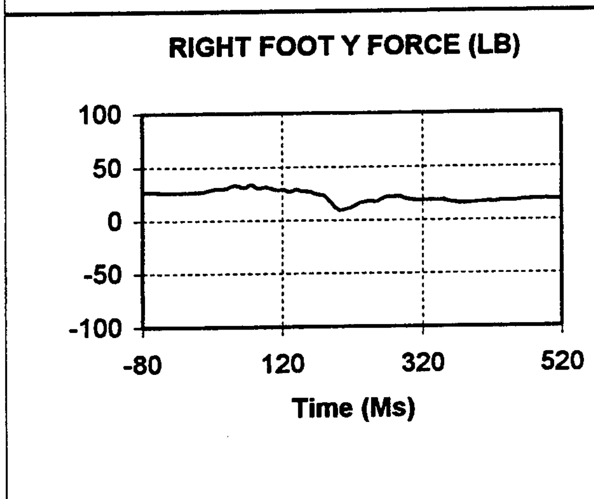
LEFT FOOT Z FORCE (LB)

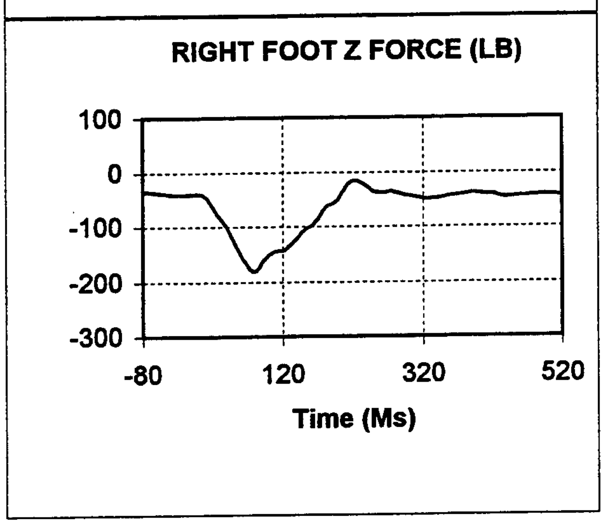


DRI Study Test: 5631 Test Date: 951031 Subj: C-13 Cell: C

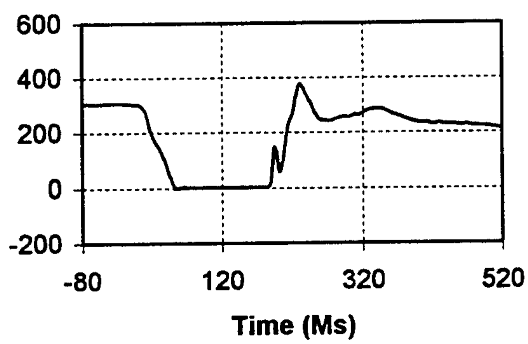




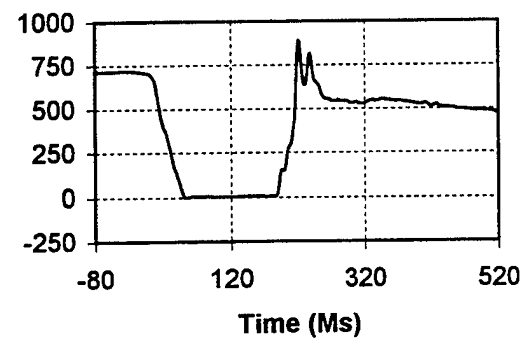




LEFT SEAT BACK X FORCE (LB)



SEAT BACK X SUM (LB)



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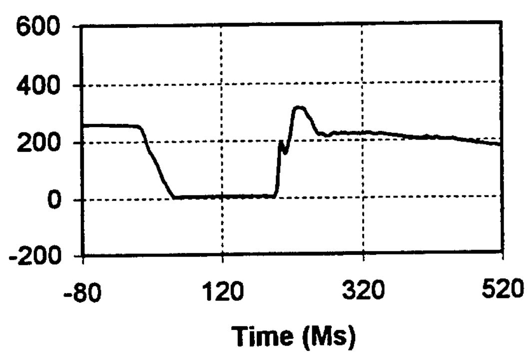
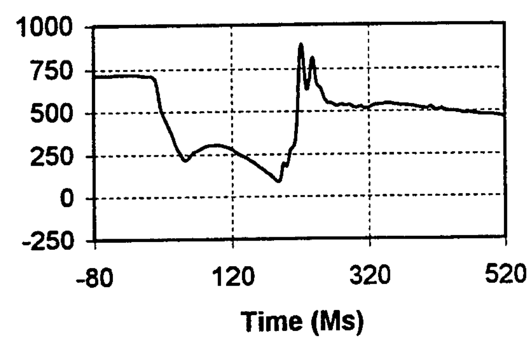
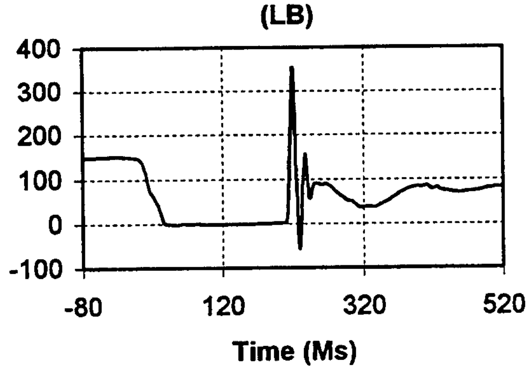


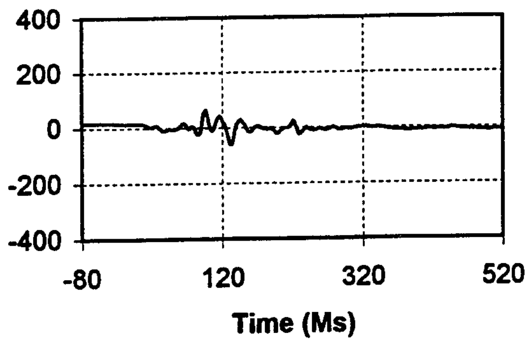
SEAT BACK X MINUS TARE (LB)



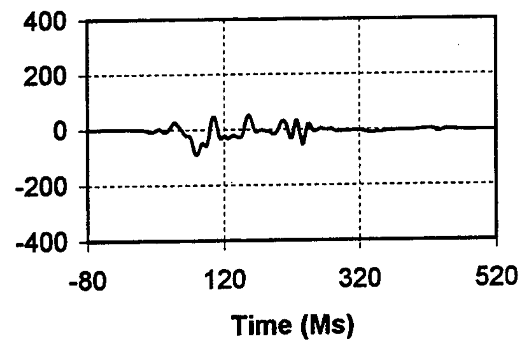
CENTER SEAT BACK X FORCE (LB)



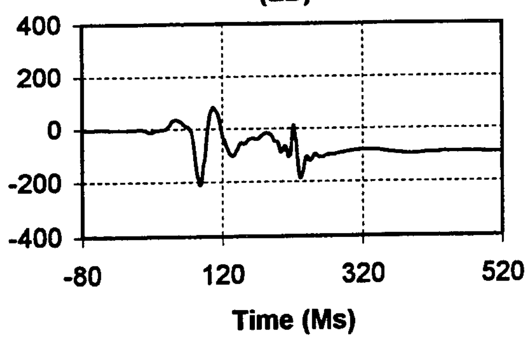
TOP SEAT BACK Y FORCE (LB)



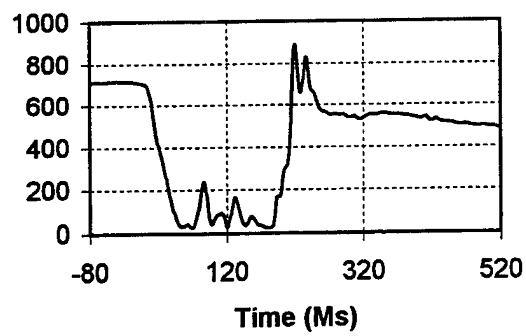
SEAT BACK Z FORCE (LB)



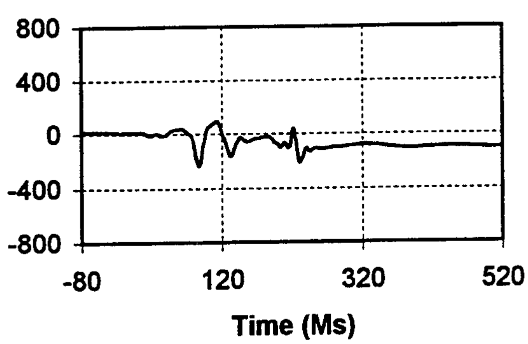
BOTTOM SEAT BACK Y FORCE (LB)



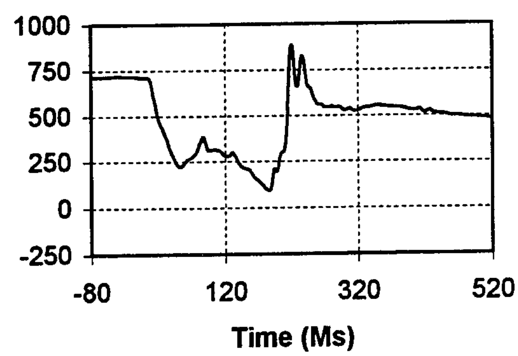
SEAT BACK RESULTANT (LB)



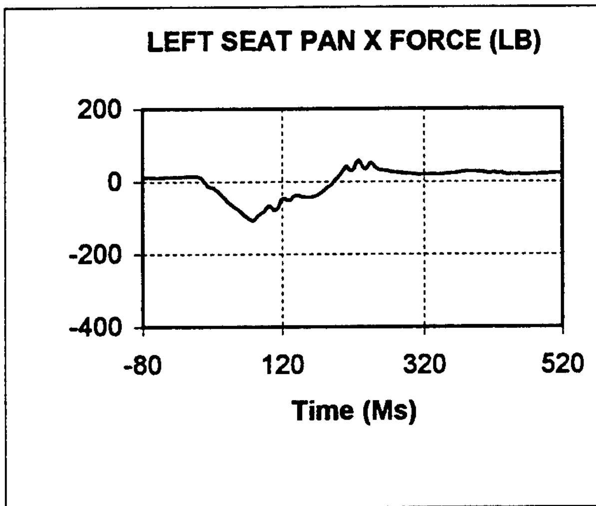
SEAT BACK Y SUM (LB)

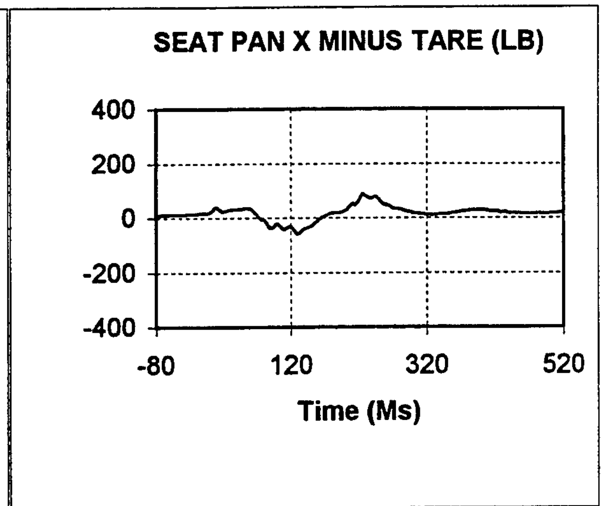


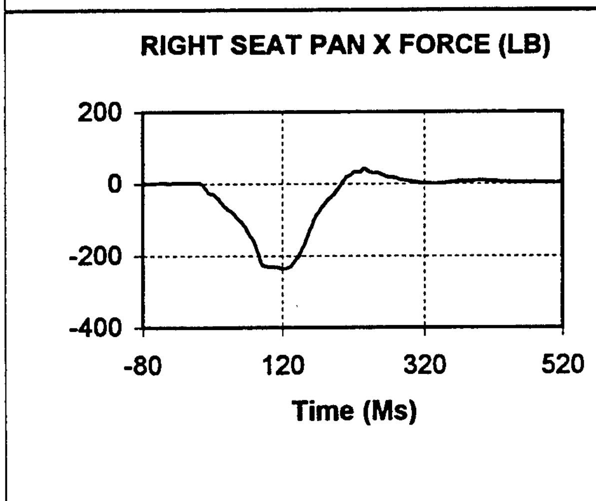
SEAT BACK RES MINUS TARE (LB)

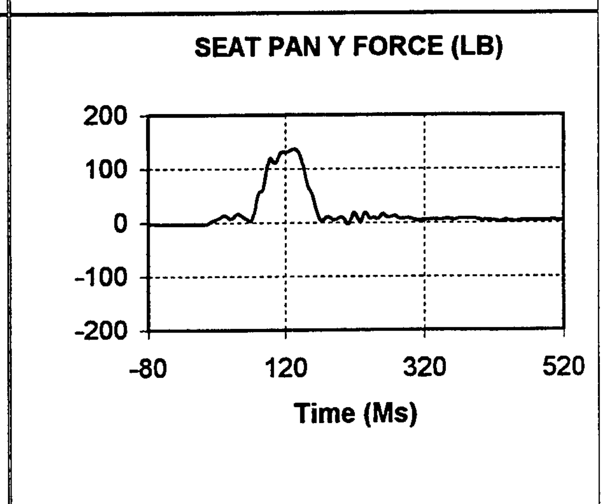


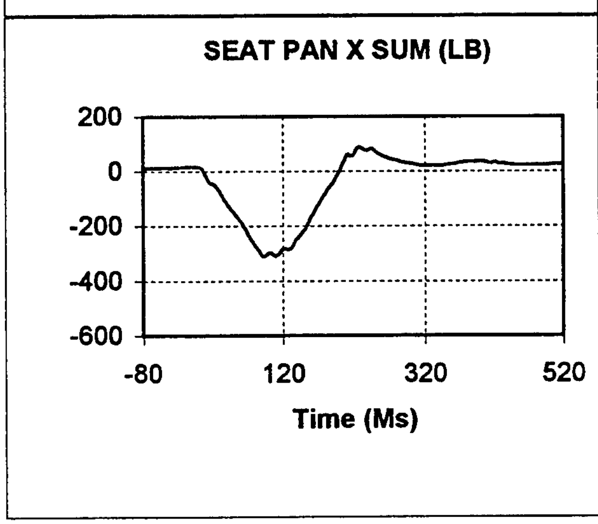
DRI Study Test: 5631 Test Date: 951031 Subj: C-13 Cell: C



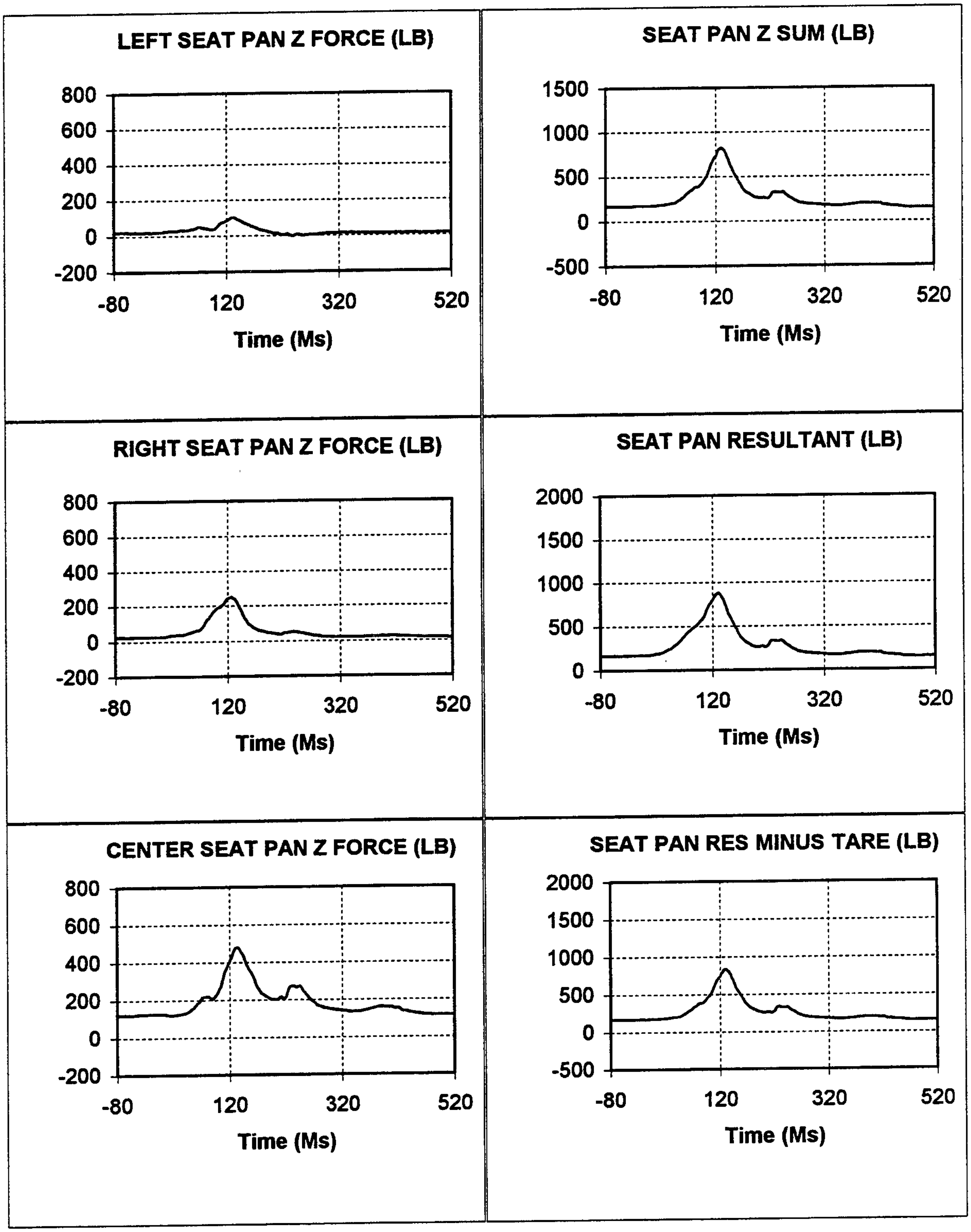








DRI Study Test: 5631 Test Date: 951031 Subj: C-13 Cell: C



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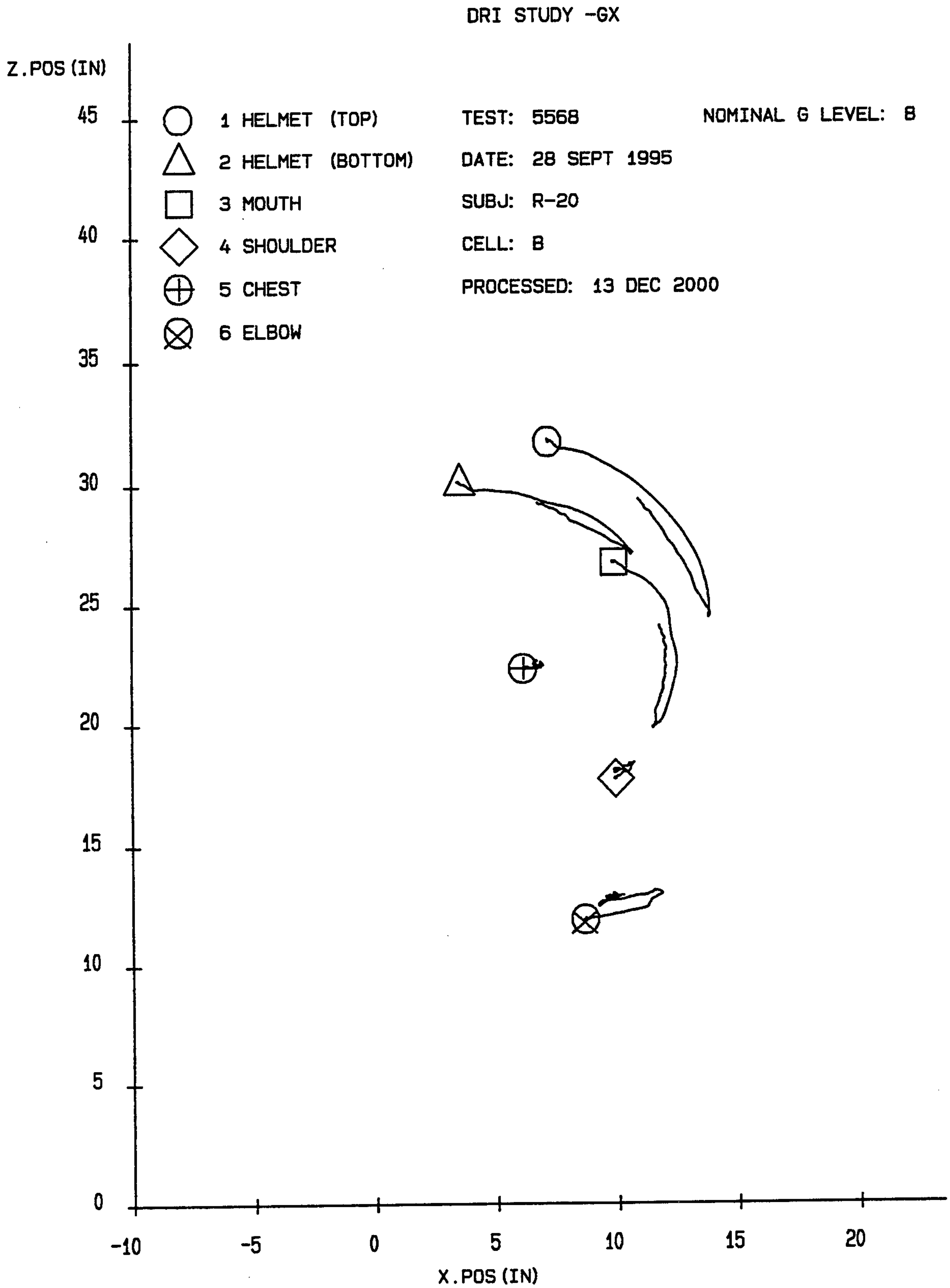
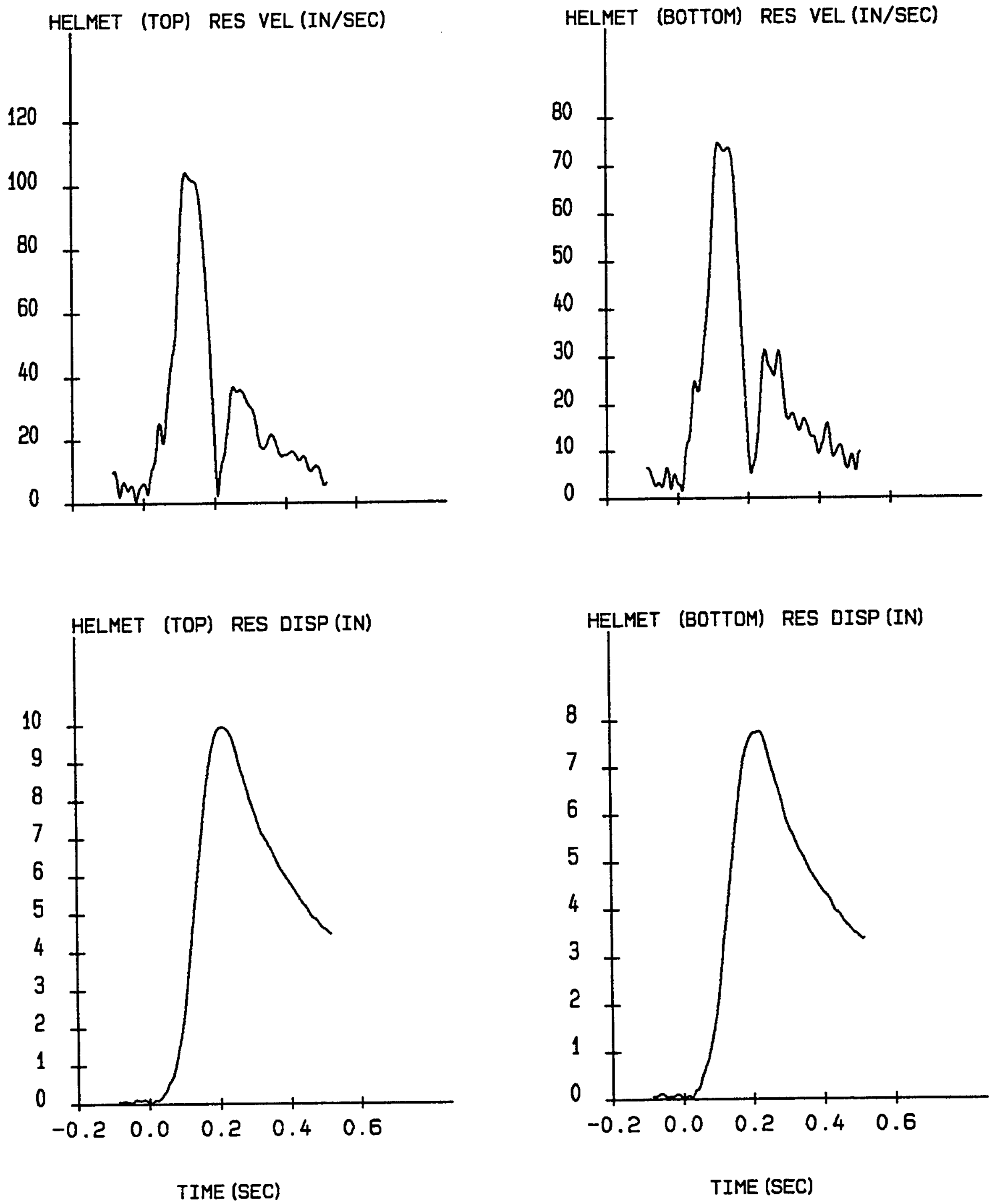
APPENDIX C

SAMPLE SELSPOT DATA


DRI STUDY -GX
Z.POS (IN)
45
40
35
30
25
20
15
10
5
0
1 HELMET (TOP)
2 HELMET (BOTTOM)
3 MOUTH
4 SHOULDER
5 CHEST
6 ELBOW
TEST: 5568
NOMINAL G LEVEL: 8
DATE: 28 SEPT 1995
SUBJ: R-20
CELL: B
PROCESSED: 13 DEC 2000
-10
-5
0
5
10
15
20
X.POS (IN)

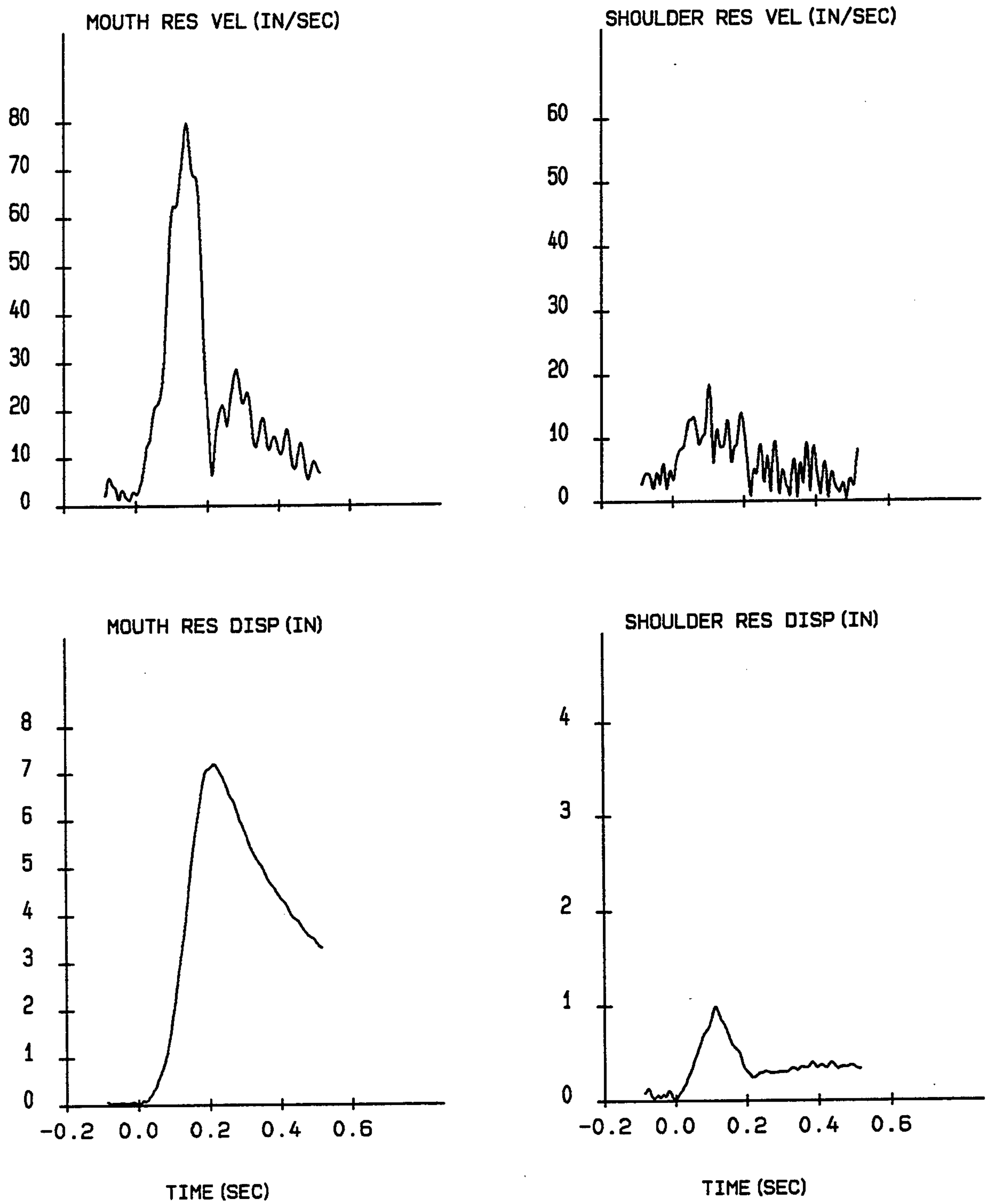
DRI STUDY -GX

TEST: 5568 DATE: 28 SEPT 1995 SUBJ: R-20 CELL: B



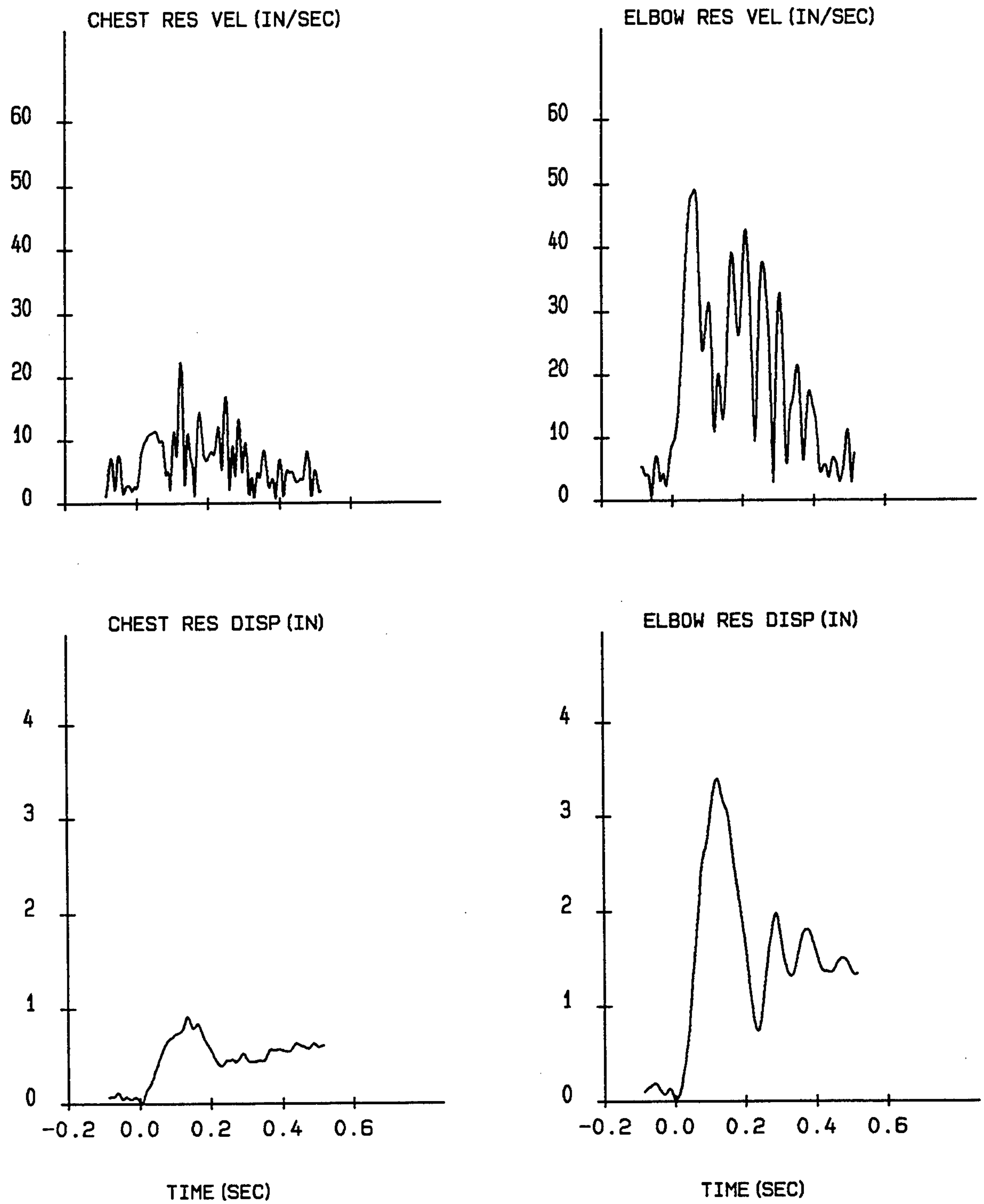
DRI STUDY -GX

TEST: 5568 DATE: 28 SEPT 1995 SUBJ: R-20 CELL: B



DRI STUDY -GX

TEST: 5568 DATE: 28 SEPT 1995 SUBJ: R-20 CELL: B



DRI STUDY -GX

TEST: 5568 DATE: 28 SEPT 1995 SUBJ: R-20 CELL: B

RELIABILITY FACTORS (IN)					
TARGET DESCRIPTION	MAXIMUM	MINIMUM	AVERAGE	STANDARD DEVIATION	AT MAX DISPLACEMENT
1 HELMET (TOP)	0.0671	0.0007	0.0240	0.0161	0.0459
2 HELMET (BOTTOM)	0.0792	0.0002	0.0390	0.0195	0.0466
3 MOUTH	0.1776	0.0011	0.0649	0.0403	0.1649
4 SHOULDER	0.1207	0.0112	0.0616	0.0209	0.0501
5 CHEST	0.1677	0.0404	0.0876	0.0244	0.1503
6 ELBOW	0.2111	0.0115	0.1071	0.0351	0.0764

PREIMPACT POSITION (IN)			
TARGET DESCRIPTION	X	Y	Z
1 HELMET (TOP)	7.1711	3.7648	31.7577
2 HELMET (BOTTOM)	3.4994	5.1054	30.0608
3 MOUTH	9.8564	0.2324	26.7421
4 SHOULDER	9.9709	0.1750	17.7396
5 CHEST	6.2200	6.6595	22.2667
6 ELBOW	8.7666	7.0442	11.9075

TARGET	MAXIMUM	TIME(SEC)	MINIMUM	TIME(SEC)
HELMET (TOP)				
POSITION(IN)				
X AXIS	13.8771	0.2260	7.1407	0.0160
Y AXIS	4.6722	0.3460	3.5934	0.0380
Z AXIS	31.7717	0.0320	24.3943	0.2080
VELOCITY(IN/SEC)	104.1204	0.1200	2.4044	0.2080
ACCELERATION(G)	6.2833	0.1880	0.2042	0.4260
DISPLACEMENT(IN)				
X AXIS	6.7059	0.2260	-0.0304	0.0160
Y AXIS	0.9075	0.3460	-0.1714	0.0380
Z AXIS	0.0141	0.0320	-7.3633	0.2080
RESULTANT	9.9430	0.2100	0.0000	0.0000

DRI STUDY -GX

TEST: 5568 DATE: 28 SEPT 1995 SUBJ: R-20 CELL: B

TARGET	MAXIMUM	TIME(SEC)	MINIMUM	TIME(SEC)
HELMET (BOTTOM)				
POSITION(IN)				
X AXIS	10.6692	0.2220	3.4600	0.0160
Y AXIS	5.8563	0.3460	4.9694	0.0360
Z AXIS	30.1116	0.0140	27.0607	0.2060
VELOCITY(IN/SEC)	74.7719	0.1160	1.7145	0.0120
ACCELERATION(G)	5.0240	0.1760	0.2779	0.3200
DISPLACEMENT(IN)				
X AXIS	7.1699	0.2220	-0.0394	0.0160
Y AXIS	0.7509	0.3460	-0.1360	0.0360
Z AXIS	0.0507	0.0140	-3.0001	0.2060
RESULTANT	7.7562	0.2220	0.0000	0.0000
MOUTH				
POSITION(IN)				
X AXIS	12.5066	0.1480	9.8564	0.0000
Y AXIS	1.1033	0.2240	0.1342	0.0400
Z AXIS	26.7882	0.0160	19.7896	0.2140
VELOCITY(IN/SEC)	79.8213	0.1400	2.5632	0.0000
ACCELERATION(G)	5.5141	0.1080	0.1315	0.3580
DISPLACEMENT(IN)				
X AXIS	2.6502	0.1480	0.0000	0.0000
Y AXIS	0.8709	0.2240	-0.0982	0.0400
Z AXIS	0.0460	0.0160	-6.9525	0.2140
RESULTANT	7.1930	0.2140	0.0000	0.0000
SHOULDER				
POSITION(IN)				
X AXIS	10.7194	0.1120	9.8872	0.5080
Y AXIS	0.3427	0.1780	0.0079	0.0380
Z AXIS	18.3683	0.1120	17.7389	0.0020
VELOCITY(IN/SEC)	18.4412	0.1020	0.3575	0.4840

DRI STUDY -GX

TEST: 5568 DATE: 28 SEPT 1995 SUBJ: R-20 CELL: B

TARGET	MAXIMUM	TIME(SEC)	MINIMUM	TIME(SEC)
SHOULDER				
ACCELERATION(G)	2.6800	0.1140	0.1636	0.3200
DISPLACEMENT(IN)				
X AXIS	0.7485	0.1120	-0.0837	0.5080
Y AXIS	0.1677	0.1780	-0.1671	0.0380
Z AXIS	0.6286	0.1120	-0.0007	0.0020
RESULTANT	0.9863	0.1120	0.0000	0.0000
CHEST				
POSITION(IN)				
X AXIS	6.9428	0.1160	6.2200	0.0000
Y AXIS	6.6676	0.2400	6.0550	0.1340
Z AXIS	22.6275	0.5140	22.2644	0.0620
VELOCITY(IN/SEC)	22.3053	0.1240	0.8124	0.3880
ACCELERATION(G)	2.6841	0.2360	0.2139	0.2700
DISPLACEMENT(IN)				
X AXIS	0.7228	0.1160	0.0000	0.0000
Y AXIS	0.0080	0.2400	-0.6045	0.1340
Z AXIS	0.3607	0.5140	-0.0024	0.0620
RESULTANT	0.9176	0.1340	0.0000	0.0000
ELBOW				
POSITION(IN)				
X AXIS	11.8545	0.1200	8.7666	0.0000
Y AXIS	7.0498	0.0040	6.1264	0.3680
Z AXIS	13.1058	0.1420	11.9075	0.0000
VELOCITY(IN/SEC)	49.1430	0.0640	2.9284	0.2860
ACCELERATION(G)	6.9204	0.2320	0.1598	0.4920
DISPLACEMENT(IN)				
X AXIS	3.0878	0.1200	0.0000	0.0000
Y AXIS	0.0056	0.0040	-0.9178	0.3680
Z AXIS	1.1983	0.1420	0.0000	0.0000
RESULTANT	3.3966	0.1220	0.0000	0.0000

DRI STUDY -GX

TEST: 5568 DATE: 28 SEPT 1995 SUBJ: R-20 CELL: B

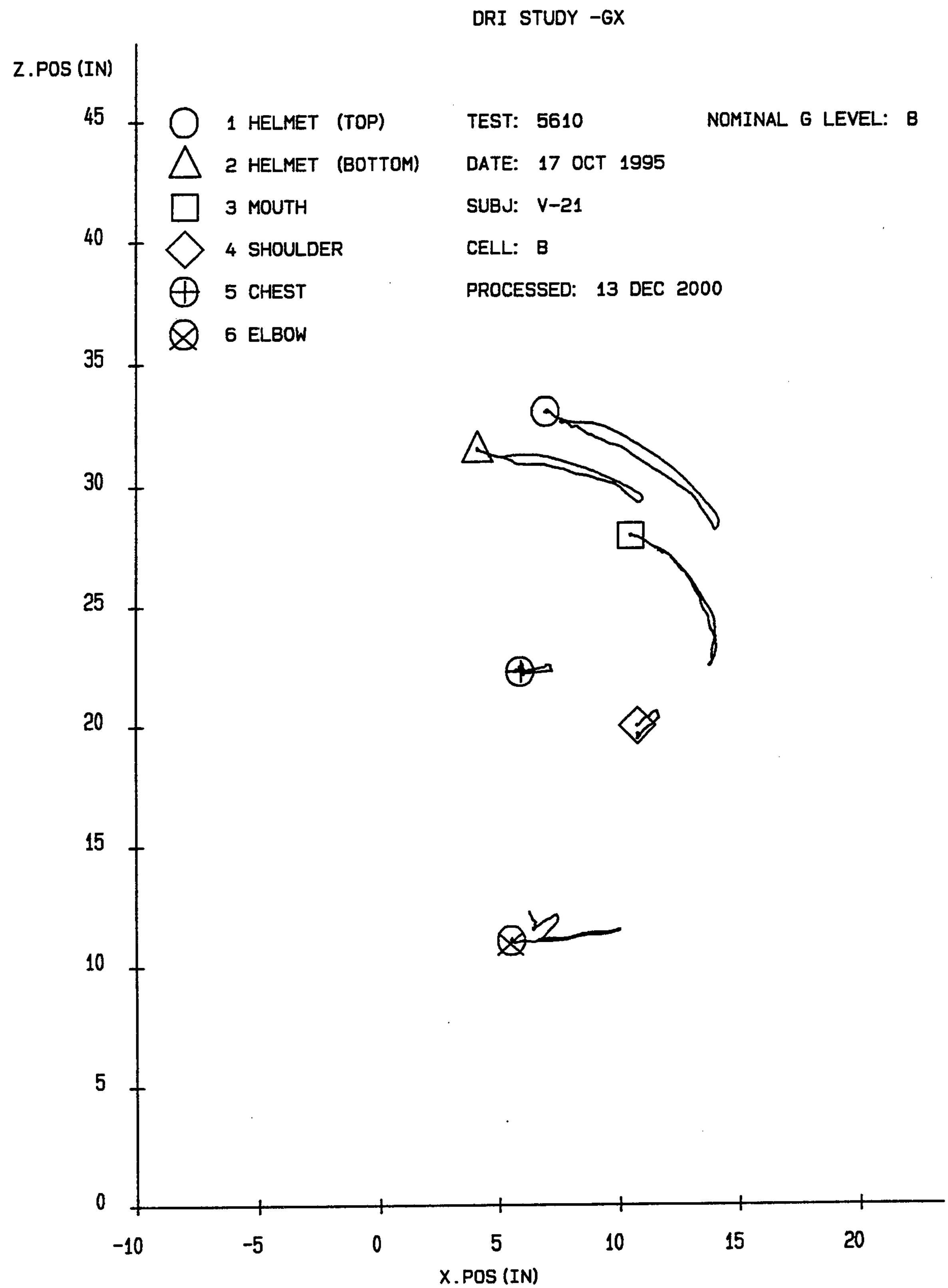
Note: Invalid samples are interpolated.

Sample number 1165 of the SHOULDER target is invalid.
Invalid sample 1165 occurred at 0.2000 seconds.

Sample number 1144 of the CHEST target is invalid.
Invalid sample 1144 occurred at 0.1580 seconds.

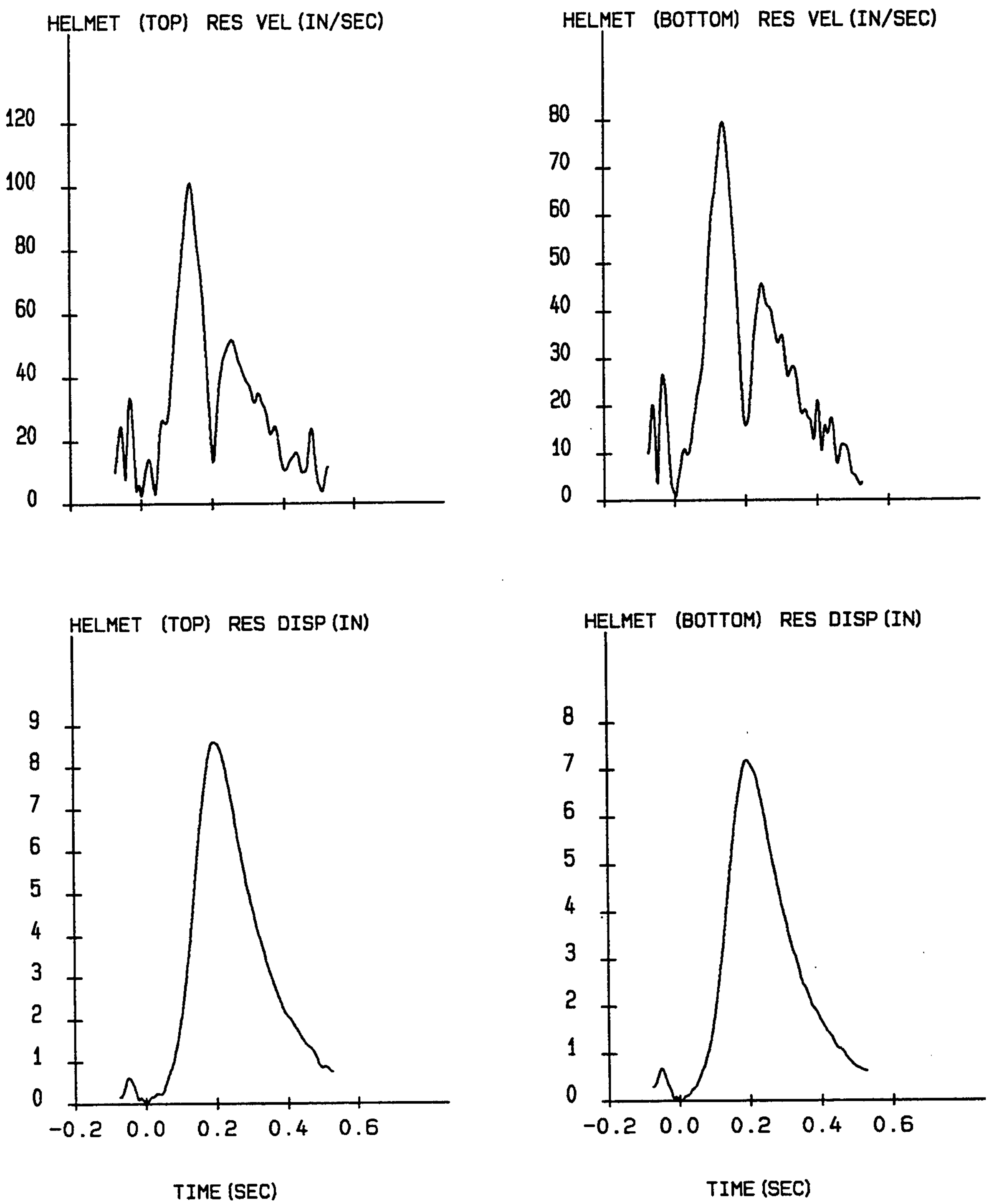
Samples 1100 through 1103 of the ELBOW target are invalid.
Invalid sample range occurred from 0.0700 seconds to 0.0760 seconds.

Sample number 1125 of the ELBOW target is invalid.
Invalid sample 1125 occurred at 0.1200 seconds.


DRI STUDY -GX
Z.POS (IN)
1 HELMET (TOP)
2 HELMET (BOTTOM)
3 MOUTH
4 SHOULDER
5 CHEST
6 ELBOW
TEST: 5610
NOMINAL G LEVEL: 8
DATE: 17 OCT 1995
SUBJ: V-21
CELL: B
PROCESSED: 13 DEC 2000
45
40
35
30
25
20
15
10
5
0
-10
-5
0
5
10
15
20
X.POS (IN)

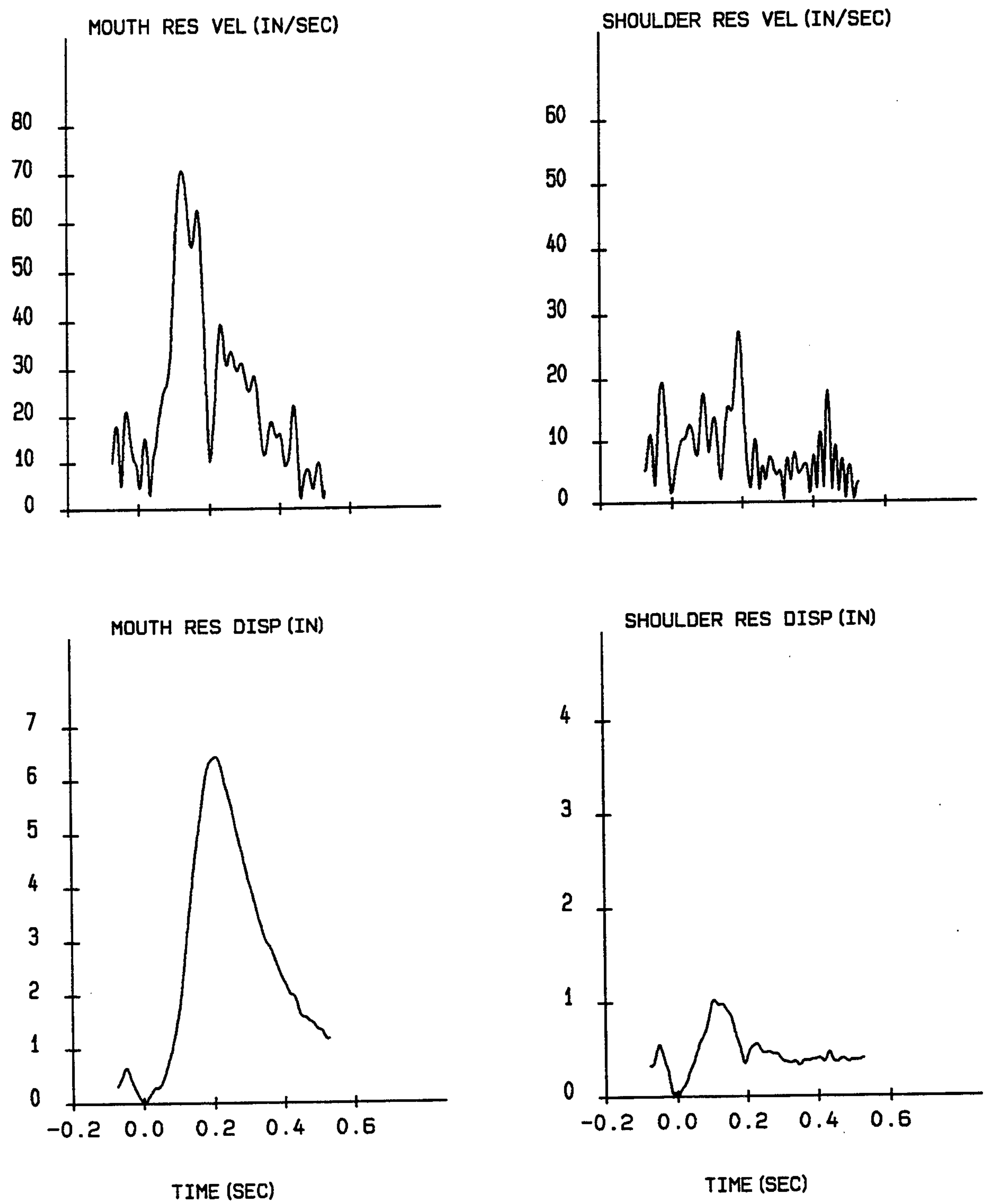
DRI STUDY -GX

TEST: 5610 DATE: 17 OCT 1995 SUBJ: V-21 CELL: B



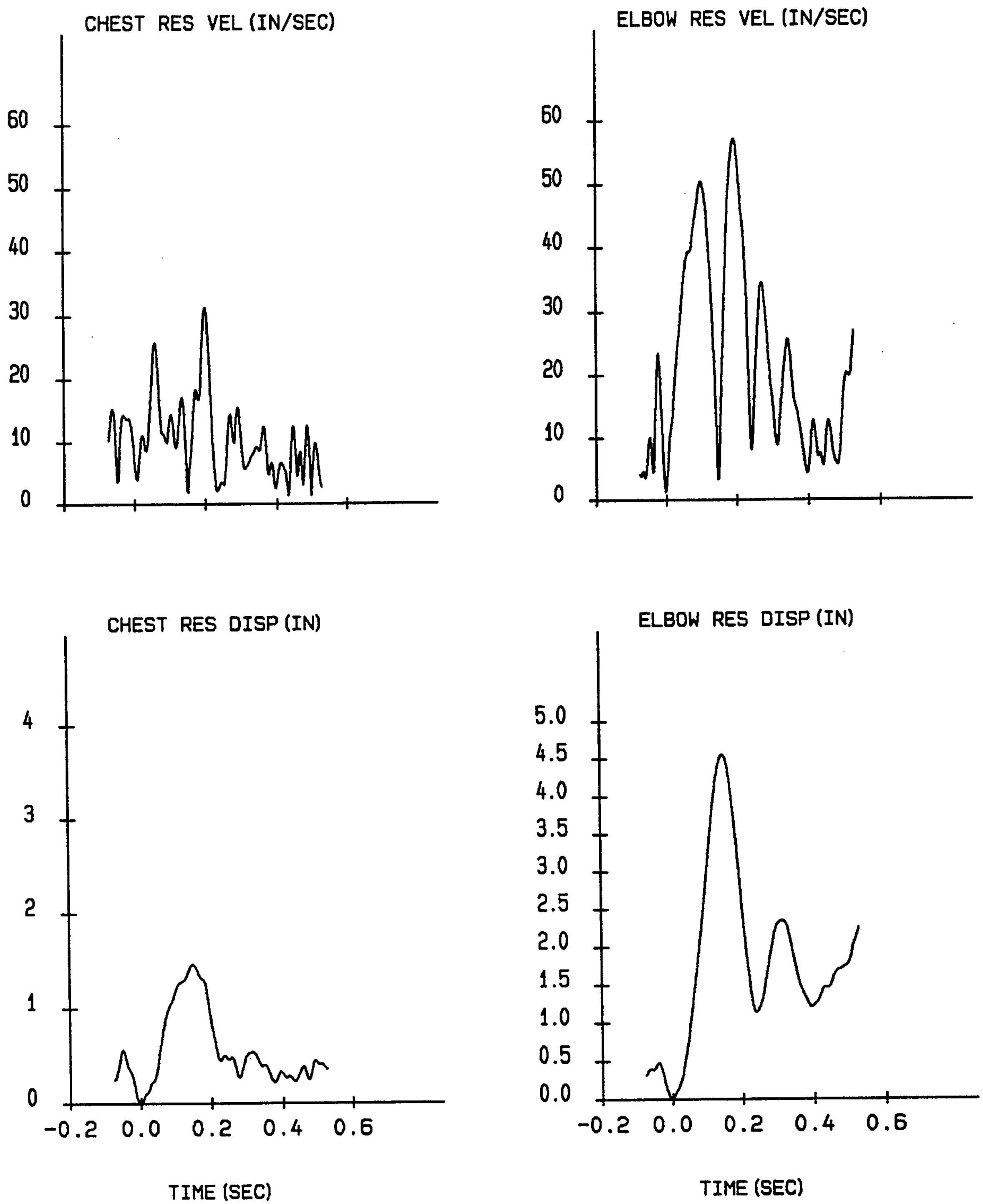
DRI STUDY -GX

TEST: 5610 DATE: 17 OCT 1995 SUBJ: V-21 CELL: B



DRI STUDY -GX

TEST: 5610 DATE: 17 OCT 1995 SUBJ: V-21 CELL: B



DRI STUDY -GX

TEST: 5610 DATE: 17 OCT 1995 SUBJ: V-21 CELL: B

RELIABILITY FACTORS (IN)					
TARGET DESCRIPTION	MAXIMUM	MINIMUM	AVERAGE	STANDARD DEVIATION	AT MAX DISPLACEMENT
1 HELMET (TOP)	0.0580	0.0003	0.0217	0.0142	0.0052
2 HELMET (BOTTOM)	0.0790	0.0008	0.0321	0.0194	0.0189
3 MOUTH	0.1017	0.0001	0.0250	0.0216	0.0278
4 SHOULDER	0.1030	0.0079	0.0526	0.0210	0.0376
5 CHEST	0.0908	0.0001	0.0450	0.0196	0.0561
6 ELBOW	0.2362	0.1046	0.1712	0.0305	0.1264

PREIMPACT POSITION (IN)			
TARGET DESCRIPTION	X	Y	Z
1 HELMET (TOP)	6.9454	3.8549	33.0096
2 HELMET (BOTTOM)	4.1193	5.0516	31.5401
3 MOUTH	10.4509	1.0572	27.9399
4 SHOULDER	10.7564	0.8581	19.9468
5 CHEST	5.9750	8.2559	22.2532
6 ELBOW	5.5024	11.0909	11.0703

TARGET	MAXIMUM	TIME(SEC)	MINIMUM	TIME(SEC)
HELMET (TOP)				
POSITION(IN)				
X AXIS	14.1478	0.1880	6.9391	0.0040
Y AXIS	4.2073	0.3400	3.2663	0.1720
Z AXIS	33.0800	0.0140	28.1438	0.2020
VELOCITY(IN/SEC)	101.1176	0.1380	2.5466	0.0000
ACCELERATION(G)	7.1567	0.1920	0.1076	0.4300
DISPLACEMENT(IN)				
X AXIS	7.2024	0.1880	-0.0063	0.0040
Y AXIS	0.3524	0.3400	-0.5886	0.1720
Z AXIS	0.0704	0.0140	-4.8659	0.2020
RESULTANT	8.6063	0.1960	0.0000	0.0000

DRI STUDY -GX

TEST: 5610 DATE: 17 OCT 1995 SUBJ: V-21 CELL: B

TARGET	MAXIMUM	TIME(SEC)	MINIMUM	TIME(SEC)
HELMET (BOTTOM)				
POSITION(IN)				
X AXIS	10.9767	0.1920	4.1193	0.0000
Y AXIS	5.2252	0.0600	4.2847	0.1760
Z AXIS	31.5440	0.0040	29.2976	0.2060
VELOCITY(IN/SEC)	79.5505	0.1360	0.8440	0.0020
ACCELERATION(G)	5.9678	0.1860	0.3084	0.5140
DISPLACEMENT(IN)				
X AXIS	6.8574	0.1920	0.0000	0.0000
Y AXIS	0.1737	0.0600	-0.7669	0.1760
Z AXIS	0.0039	0.0040	-2.2425	0.2060
RESULTANT	7.1957	0.1920	0.0000	0.0000
MOUTH				
POSITION(IN)				
X AXIS	14.0377	0.1740	10.4509	0.0000
Y AXIS	1.7577	0.3020	0.9378	0.1140
Z AXIS	27.9399	0.0000	22.4460	0.2040
VELOCITY(IN/SEC)	70.6761	0.1220	2.1256	0.4600
ACCELERATION(G)	5.9648	0.1940	0.1241	0.4960
DISPLACEMENT(IN)				
X AXIS	3.5868	0.1740	0.0000	0.0000
Y AXIS	0.7004	0.3020	-0.1194	0.1140
Z AXIS	0.0000	0.0000	-5.4939	0.2040
RESULTANT	6.4328	0.2080	0.0000	0.0000
SHOULDER				
POSITION(IN)				
X AXIS	11.6691	0.1300	10.7507	0.2280
Y AXIS	1.1025	0.4300	0.7653	0.2040
Z AXIS	20.5444	0.1020	19.3982	0.2240
VELOCITY(IN/SEC)	27.4034	0.1900	0.5692	0.3160

DRI STUDY -GX

TEST: 5610 DATE: 17 OCT 1995 SUBJ: V-21 CELL: B

TARGET	MAXIMUM	TIME(SEC)	MINIMUM	TIME(SEC)
SHOULDER				
ACCELERATION(G)	3.2094	0.2120	0.3150	0.2320
DISPLACEMENT(IN)				
X AXIS	0.9127	0.1300	-0.0057	0.2280
Y AXIS	0.2444	0.4300	-0.0929	0.2040
Z AXIS	0.5976	0.1020	-0.5486	0.2240
RESULTANT	1.0226	0.1040	0.0000	0.0000
CHEST				
POSITION(IN)				
X AXIS	7.2163	0.1540	5.6519	0.5200
Y AXIS	8.2559	0.0000	7.3510	0.1820
Z AXIS	22.5505	0.3240	22.0858	0.2560
VELOCITY(IN/SEC)	31.2987	0.2000	1.4329	0.4980
ACCELERATION(G)	3.6775	0.2180	0.2280	0.3900
DISPLACEMENT(IN)				
X AXIS	1.2413	0.1540	-0.3232	0.5200
Y AXIS	0.0000	0.0000	-0.9049	0.1820
Z AXIS	0.2973	0.3240	-0.1675	0.2560
RESULTANT	1.4608	0.1480	0.0000	0.0000
ELBOW				
POSITION(IN)				
X AXIS	10.0329	0.1480	5.5024	0.0000
Y AXIS	12.8674	0.5260	10.7660	0.2040
Z AXIS	12.2294	0.5260	10.9533	0.0200
VELOCITY(IN/SEC)	57.1204	0.1920	1.7109	0.0000
ACCELERATION(G)	5.0276	0.1480	0.1968	0.4120
DISPLACEMENT(IN)				
X AXIS	4.5305	0.1480	0.0000	0.0000
Y AXIS	1.7764	0.5260	-0.3249	0.2040
Z AXIS	1.1591	0.5260	-0.1170	0.0200
RESULTANT	4.5516	0.1480	0.0000	0.0000

DRI STUDY -GX

TEST: 5610 DATE: 17 OCT 1995 SUBJ: V-21 CELL: B

Note: Invalid samples are interpolated.

Samples 1021 through 1080 of the MOUTH target are invalid.
Invalid sample range occurred from -0.0740 seconds to 0.0440 seconds.

Samples 1143 through 1152 of the MOUTH target are invalid.
Invalid sample range occurred from 0.1700 seconds to 0.1880 seconds.

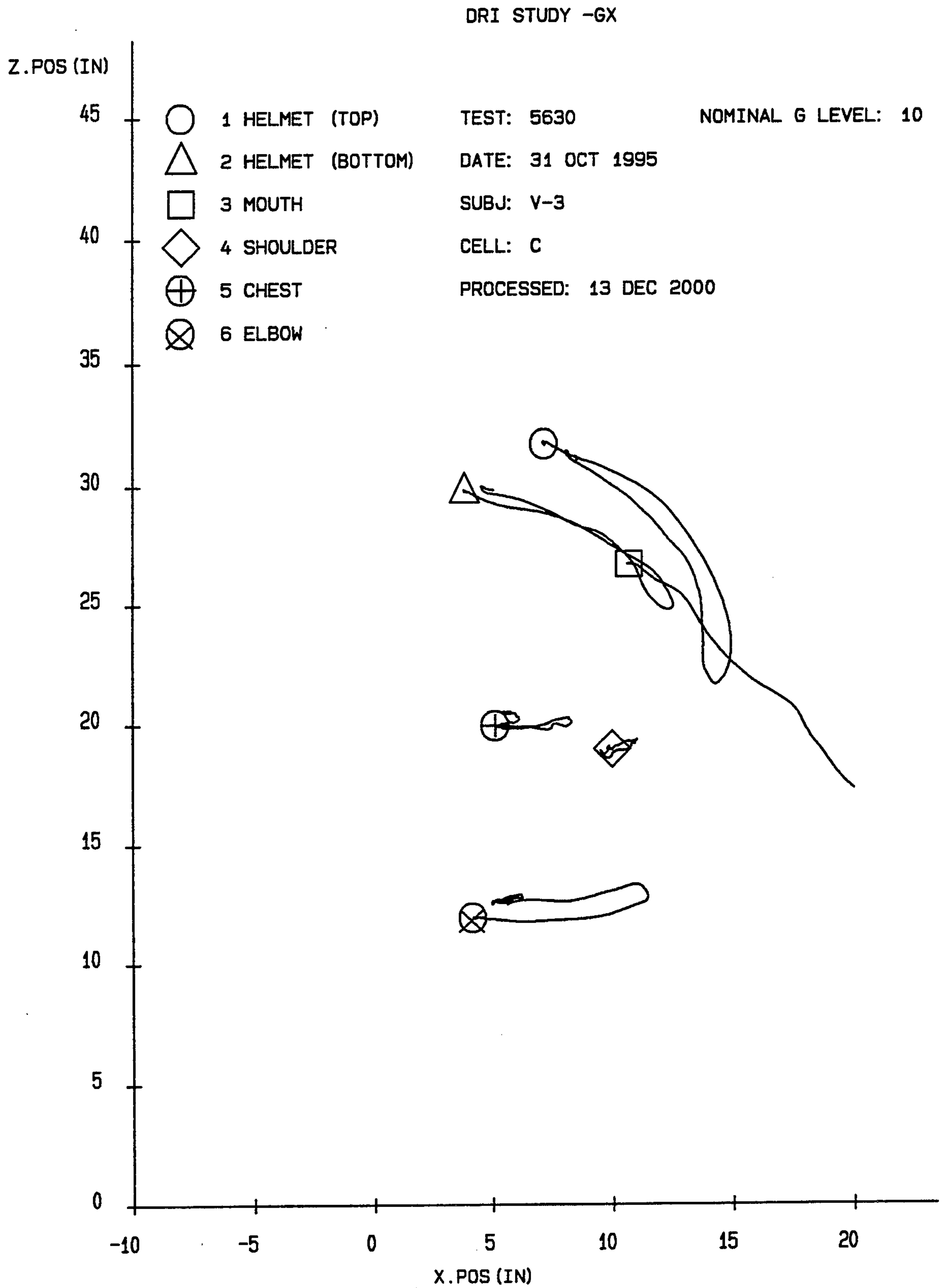
Samples 1175 through 1179 of the MOUTH target are invalid.
Invalid sample range occurred from 0.2340 seconds to 0.2420 seconds.

Samples 1295 through 1321 of the MOUTH target are invalid.
Invalid sample range occurred from 0.4740 seconds to 0.5260 seconds.

Samples 1155 through 1163 of the ELBOW target are invalid.
Invalid sample range occurred from 0.1940 seconds to 0.2100 seconds.

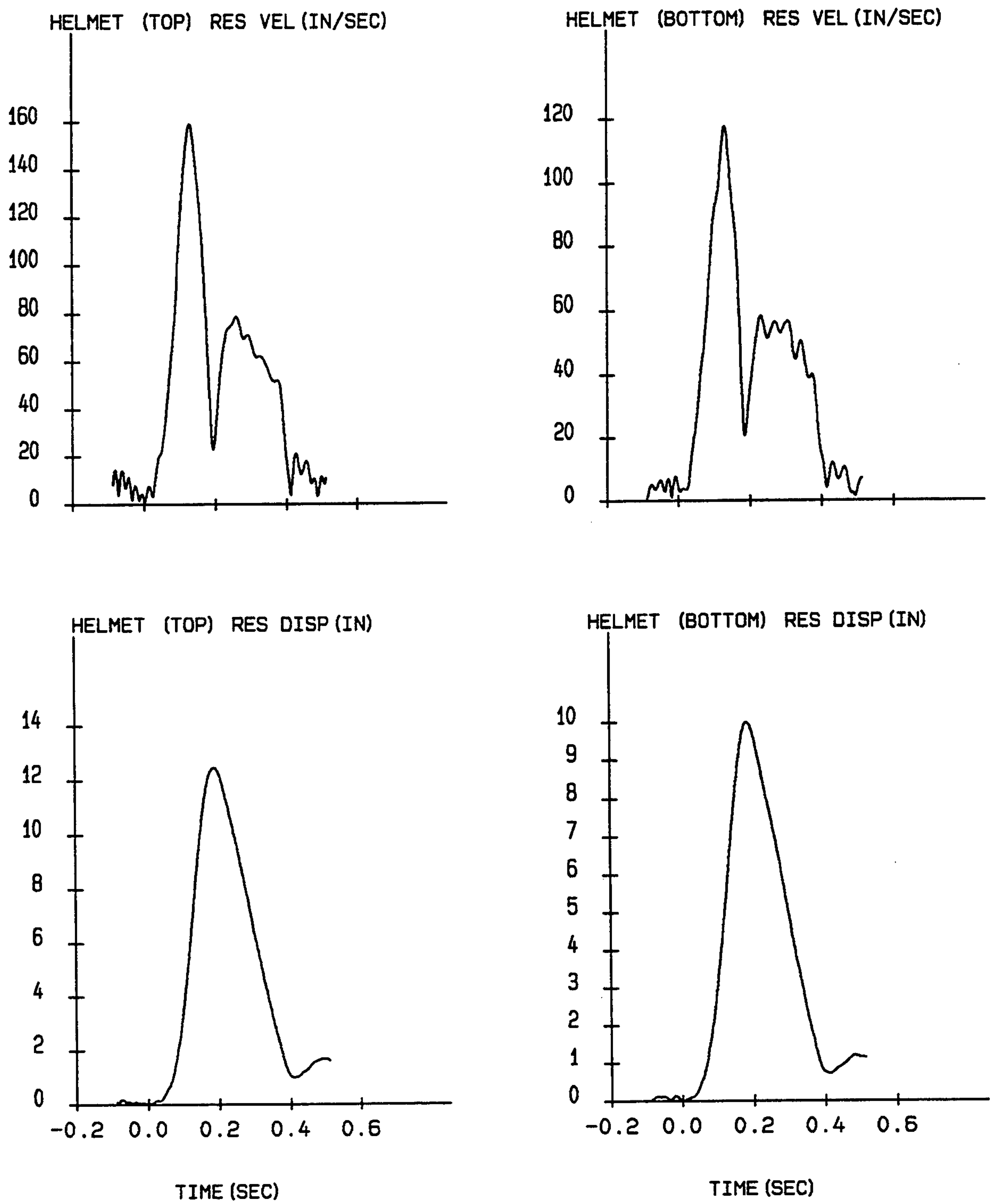
Samples 1173 through 1189 of the ELBOW target are invalid.
Invalid sample range occurred from 0.2300 seconds to 0.2620 seconds.

Samples 1219 through 1229 of the ELBOW target are invalid.
Invalid sample range occurred from 0.3220 seconds to 0.3420 seconds.


DRI STUDY -GX
Z.POS (IN)
1 HELMET (TOP)
2 HELMET (BOTTOM)
3 MOUTH
4 SHOULDER
5 CHEST
6 ELBOW
TEST: 5630
NOMINAL G LEVEL: 10
DATE: 31 OCT 1995
SUBJ: V-3
CELL: C
PROCESSED: 13 DEC 2000
45
40
35
30
25
20
15
10
5
0
-10
-5
0
5
10
15
20
X.POS (IN)

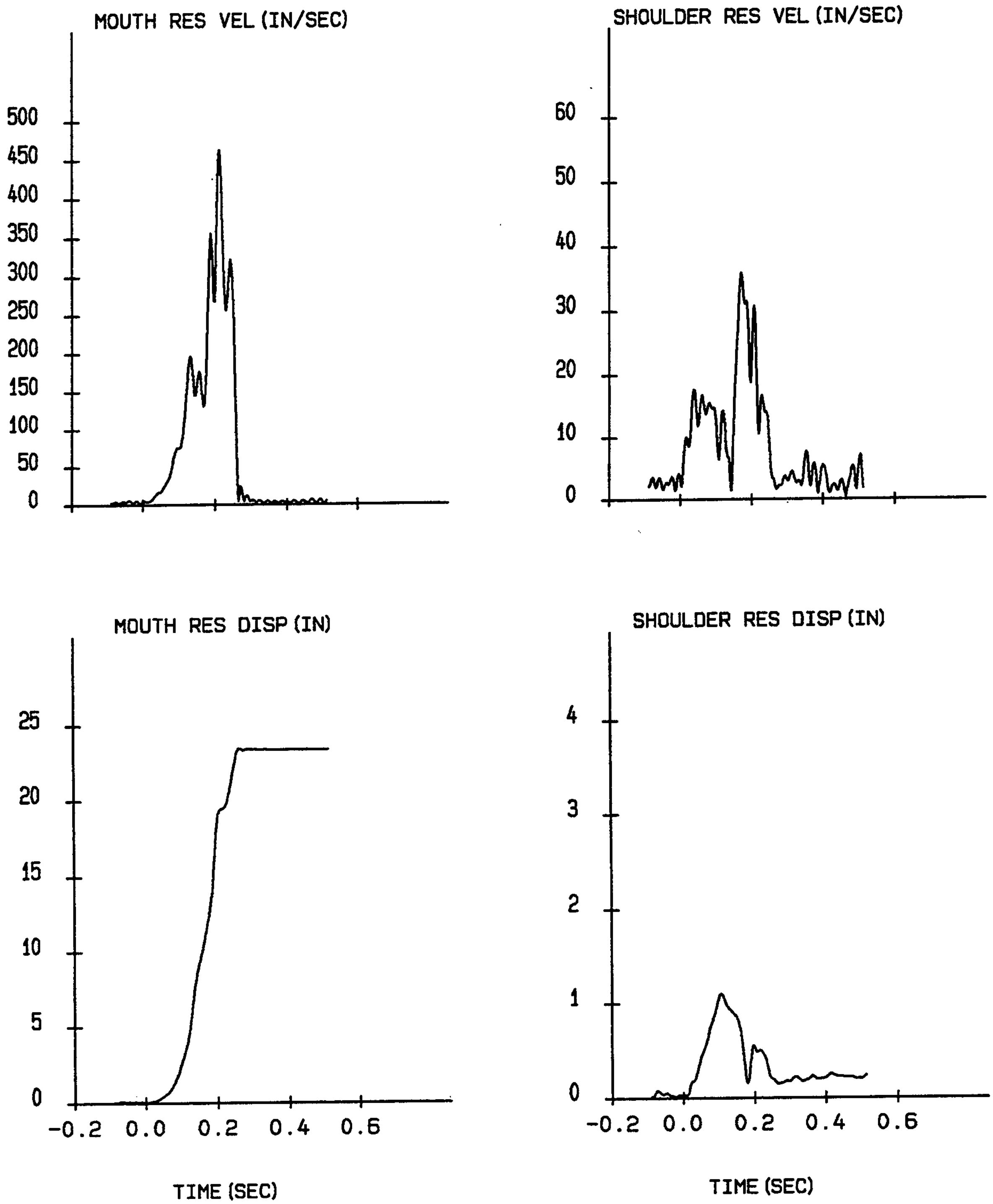
DRI STUDY -GX

TEST: 5630 DATE: 31 OCT 1995 SUBJ: V-3 CELL: C



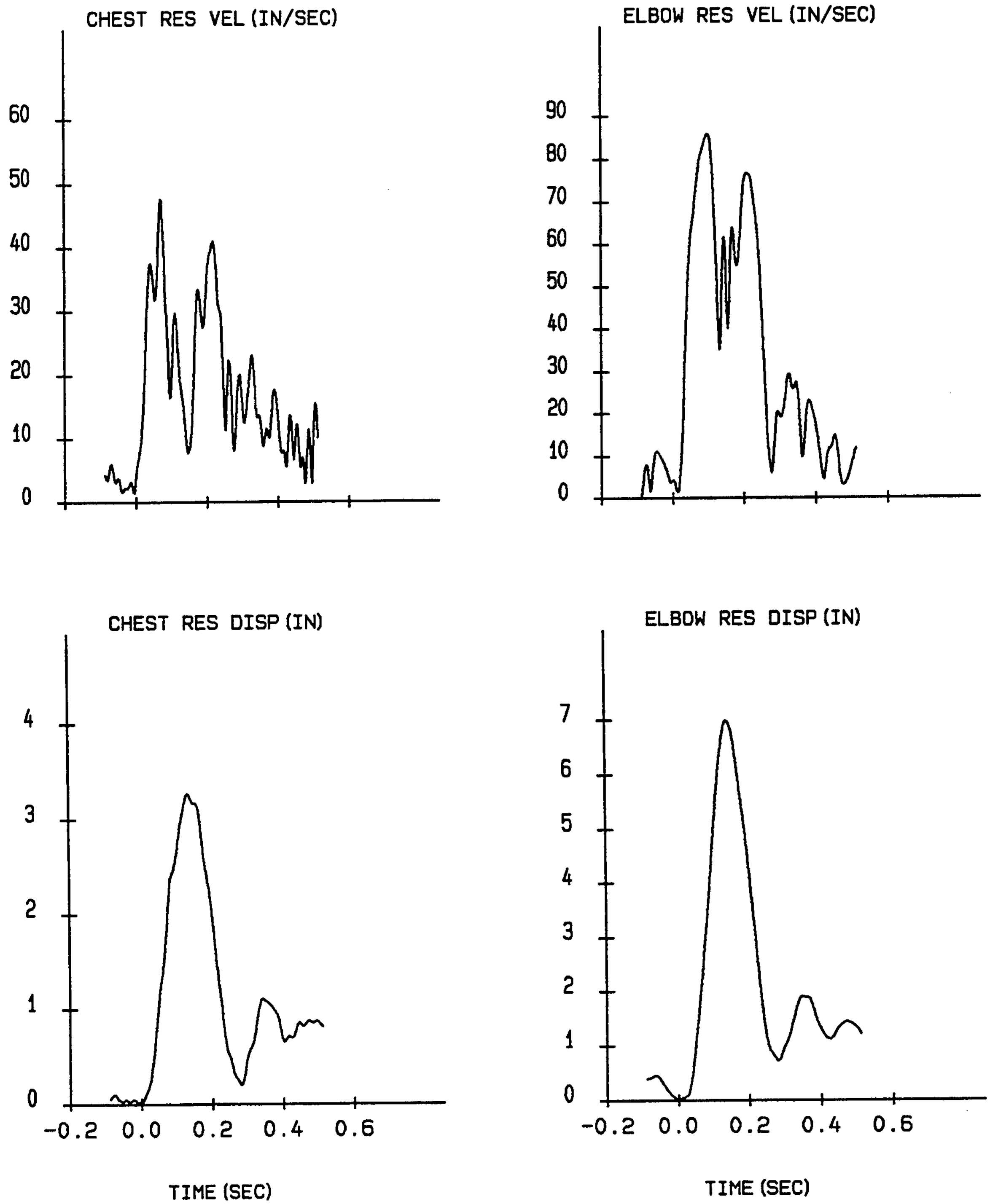
DRI STUDY -GX

TEST: 5630 DATE: 31 OCT 1995 SUBJ: V-3 CELL: C



DRI STUDY -GX

TEST: 5630 DATE: 31 OCT 1995 SUBJ: V-3 CELL: C



DRI STUDY -GX

TEST: 5630 DATE: 31 OCT 1995 SUBJ: V-3 CELL: C

RELIABILITY FACTORS (IN)

TARGET DESCRIPTION	MAXIMUM	MINIMUM	AVERAGE	STANDARD DEVIATION	AT MAX DISPLACEMENT
1 HELMET (TOP)	0.1256	0.0002	0.0409	0.0291	0.0244
2 HELMET (BOTTOM)	0.1849	0.0350	0.0993	0.0339	0.0869
3 MOUTH	13.1058	0.0001	8.1817	5.9075	13.1003
4 SHOULDER	0.1574	0.0001	0.0270	0.0280	0.0110
5 CHEST	0.2999	0.0001	0.0584	0.0514	0.0280
6 ELBOW	0.1653	0.0003	0.0327	0.0317	0.0025

PREIMPACT POSITION (IN)

TARGET DESCRIPTION	X	Y	Z
1 HELMET (TOP)	7.1350	4.4488	31.7819
2 HELMET (BOTTOM)	3.8380	5.3882	29.7826
3 MOUTH	10.6877	0.5312	26.7135
4 SHOULDER	10.0094	0.3008	18.9601
5 CHEST	5.1487	7.9490	19.9131
6 ELBOW	4.5697	9.3454	11.9048

TARGET	MAXIMUM	TIME(SEC)	MINIMUM	TIME(SEC)
HELMET (TOP)				
POSITION(IN)				
X AXIS	14.9378	0.1640	7.1322	0.0040
Y AXIS	4.5707	0.1060	3.8183	0.4900
Z AXIS	31.7899	0.0100	21.6022	0.1920
VELOCITY(IN/SEC)	159.0722	0.1280	1.1739	0.0000
ACCELERATION(G)	10.5633	0.1820	0.6114	0.0040
DISPLACEMENT(IN)				
X AXIS	7.8028	0.1640	-0.0028	0.0040
Y AXIS	0.1219	0.1060	-0.6305	0.4900
Z AXIS	0.0080	0.0100	-10.1797	0.1920
RESULTANT	12.4589	0.1880	0.0000	0.0000

DRI STUDY -GX

TEST: 5630 DATE: 31 OCT 1995 SUBJ: V-3 CELL: C

TARGET	MAXIMUM	TIME(SEC)	MINIMUM	TIME(SEC)
HELMET (BOTTOM)				
POSITION(IN)				
X AXIS	12.5395	0.1780	3.8373	0.0020
Y AXIS	5.6775	0.1700	5.2038	0.5000
Z AXIS	29.9942	0.4180	24.7646	0.1920
VELOCITY(IN/SEC)	117.7342	0.1300	1.6467	0.4960
ACCELERATION(G)	9.3991	0.1780	0.1931	0.4580
DISPLACEMENT(IN)				
X AXIS	8.7015	0.1780	-0.0007	0.0020
Y AXIS	0.2892	0.1700	-0.1845	0.5000
Z AXIS	0.2116	0.4180	-5.0180	0.1920
RESULTANT	9.9830	0.1820	0.0000	0.0000
MOUTH				
POSITION(IN)				
X AXIS	25.8405	0.2600	10.6877	0.0000
Y AXIS	9.6792	0.2640	-8.7283	0.1980
Z AXIS	26.7206	0.0160	11.2944	0.4820
VELOCITY(IN/SEC)	462.7796	0.2120	0.8176	0.4820
ACCELERATION(G)	76.5419	0.2000	0.2442	0.4680
DISPLACEMENT(IN)				
X AXIS	15.1528	0.2600	0.0000	0.0000
Y AXIS	9.1480	0.2640	-9.2595	0.1980
Z AXIS	0.0071	0.0160	-15.4192	0.4820
RESULTANT	23.4394	0.2640	0.0000	0.0000
SHOULDER				
POSITION(IN)				
X AXIS	11.0387	0.1080	9.5204	0.2140
Y AXIS	0.6456	0.1960	0.0776	0.0900
Z AXIS	19.3349	0.1060	18.5714	0.1960
VELOCITY(IN/SEC)	35.9415	0.1700	0.4016	0.4640

DRI STUDY -GX

TEST: 5630 DATE: 31 OCT 1995 SUBJ: V-3 CELL: C

TARGET	MAXIMUM	TIME(SEC)	MINIMUM	TIME(SEC)
SHOULDER				
ACCELERATION(G)	4.5159	0.1960	0.0972	0.4760
DISPLACEMENT(IN)				
X AXIS	1.0293	0.1080	-0.4889	0.2140
Y AXIS	0.3448	0.1960	-0.2232	0.0900
Z AXIS	0.3749	0.1060	-0.3886	0.1960
RESULTANT	1.0992	0.1080	0.0000	0.0000
CHEST				
POSITION(IN)				
X AXIS	8.2966	0.1340	5.1487	0.0000
Y AXIS	8.0579	0.2740	7.0284	0.1480
Z AXIS	20.5059	0.4440	19.7652	0.0780
VELOCITY(IN/SEC)	47.6695	0.0700	2.8659	0.4760
ACCELERATION(G)	4.1453	0.2300	0.1881	0.1920
DISPLACEMENT(IN)				
X AXIS	3.1479	0.1340	0.0000	0.0000
Y AXIS	0.1089	0.2740	-0.9206	0.1480
Z AXIS	0.5928	0.4440	-0.1479	0.0780
RESULTANT	3.2740	0.1340	0.0000	0.0000
ELBOW				
POSITION(IN)				
X AXIS	11.4798	0.1400	4.5697	0.0000
Y AXIS	9.6304	0.2260	8.2689	0.1560
Z AXIS	13.2987	0.1580	11.7423	0.0640
VELOCITY(IN/SEC)	85.9291	0.1000	1.4569	0.0140
ACCELERATION(G)	10.5778	0.1560	0.7711	0.4880
DISPLACEMENT(IN)				
X AXIS	6.9101	0.1400	0.0000	0.0000
Y AXIS	0.2850	0.2260	-1.0764	0.1560
Z AXIS	1.3940	0.1580	-0.1625	0.0640
RESULTANT	6.9754	0.1400	0.0000	0.0000

DRI STUDY -GX
TEST: 5630 DATE: 31 OCT 1995 SUBJ: V-3 CELL: C

ote: Invalid samples are interpolated.

amples 1125 through 1126 of the MOUTH target are invalid.
nvalid sample range occurred from 0.1200 seconds to 0.1220 seconds.

amples 1137 through 1321 of the MOUTH target are invalid.
nvalid sample range occurred from 0.1440 seconds to 0.5120 seconds.

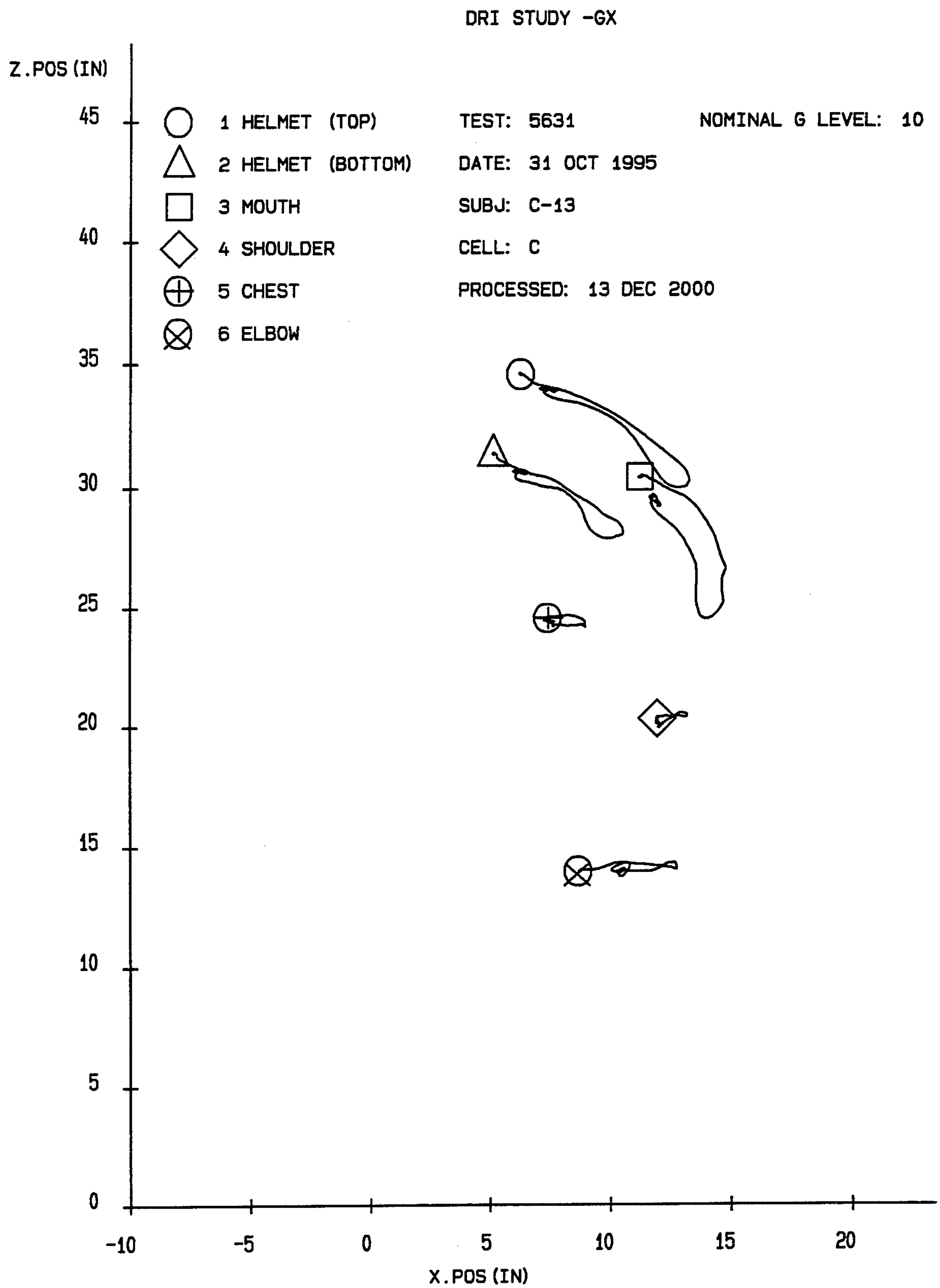
ample number 1147 of the SHOULDER target is invalid.
nvalid sample 1147 occurred at 0.1640 seconds.

amples 1226 through 1228 of the CHEST target are invalid.
nvalid sample range occurred from 0.3220 seconds to 0.3260 seconds.

Samples 1021 through 1025 of the ELBOW target are invalid.
Invalid sample range occurred from -0.0880 seconds to -0.0800 seconds.

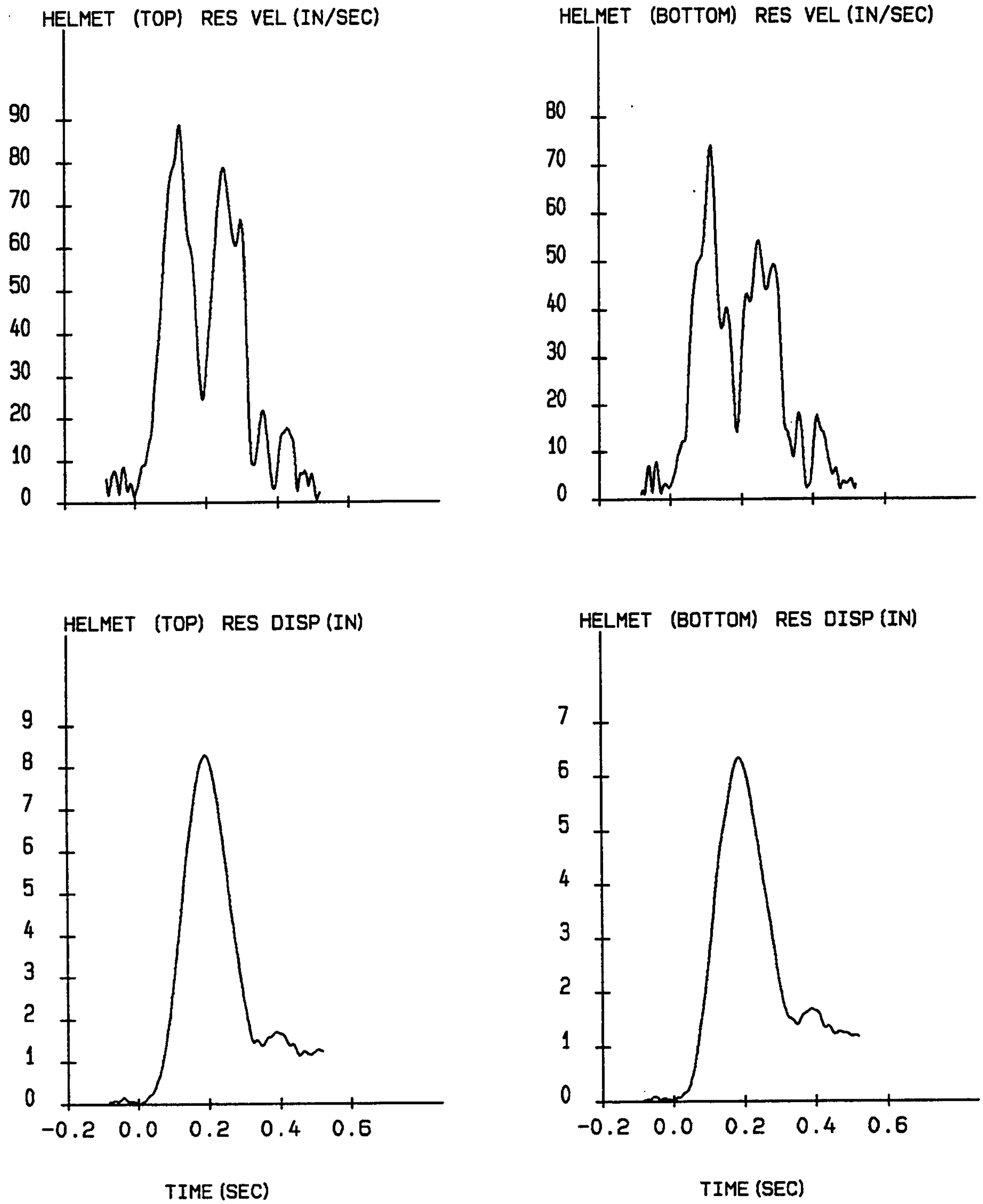
Samples 1039 through 1080 of the ELBOW target are invalid.
Invalid sample range occurred from -0.0520 seconds to 0.0300 seconds.

Sample number 1163 of the ELBOW target is invalid.
Invalid sample 1163 occurred at 0.1960 seconds.


DRI STUDY -GX
Z.POS (IN)
45
40
35
30
25
20
15
10
5
0
1 HELMET (TOP)
2 HELMET (BOTTOM)
3 MOUTH
4 SHOULDER
5 CHEST
6 ELBOW
TEST: 5631
DATE: 31 OCT 1995
SUBJ: C-13
CELL: C
PROCESSED: 13 DEC 2000
NOMINAL G LEVEL: 10
-10
-5
0
5
10
15
20
X.POS (IN)

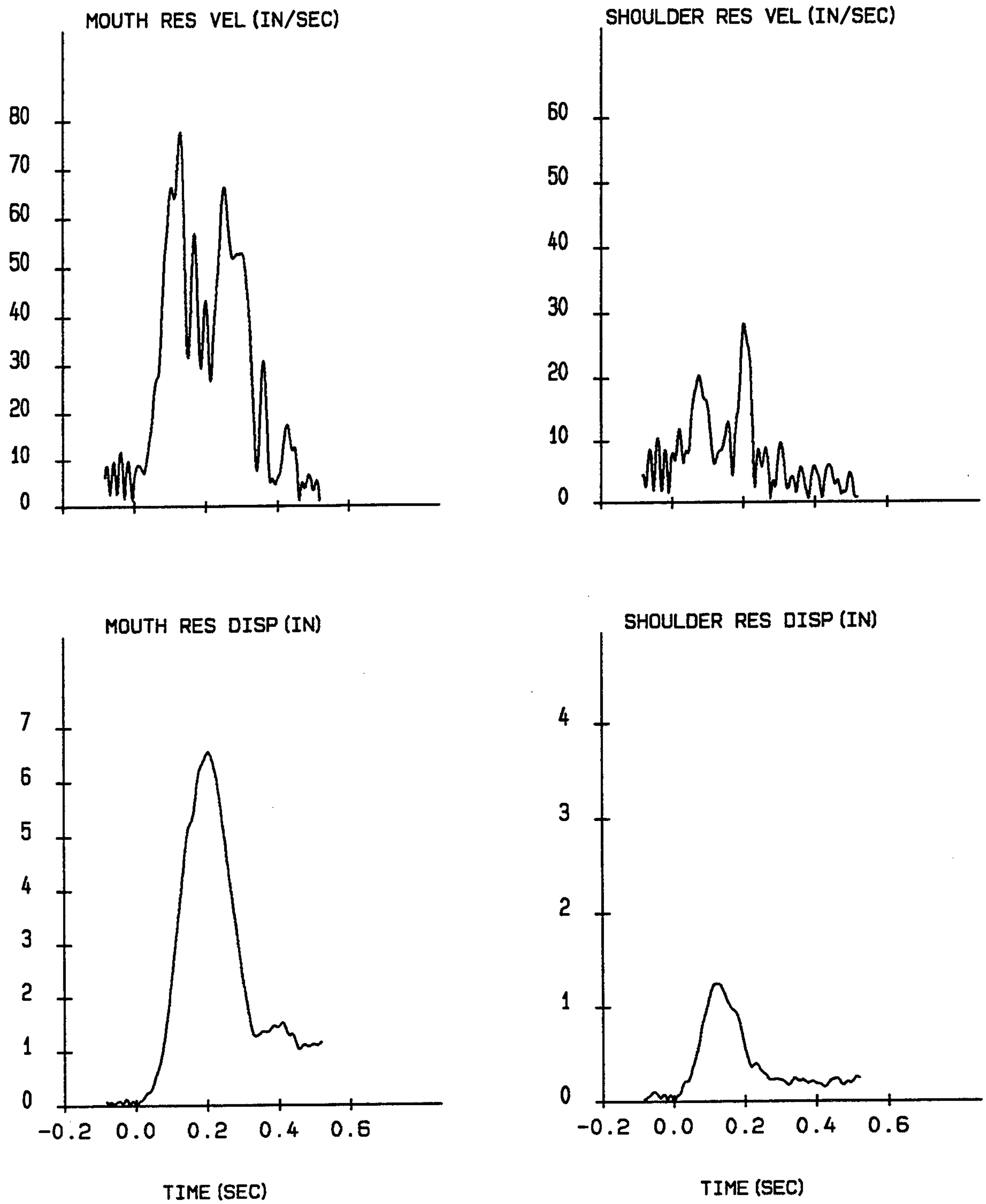
DRI STUDY -GX

TEST: 5631 DATE: 31 OCT 1995 SUBJ: C-13 CELL: C



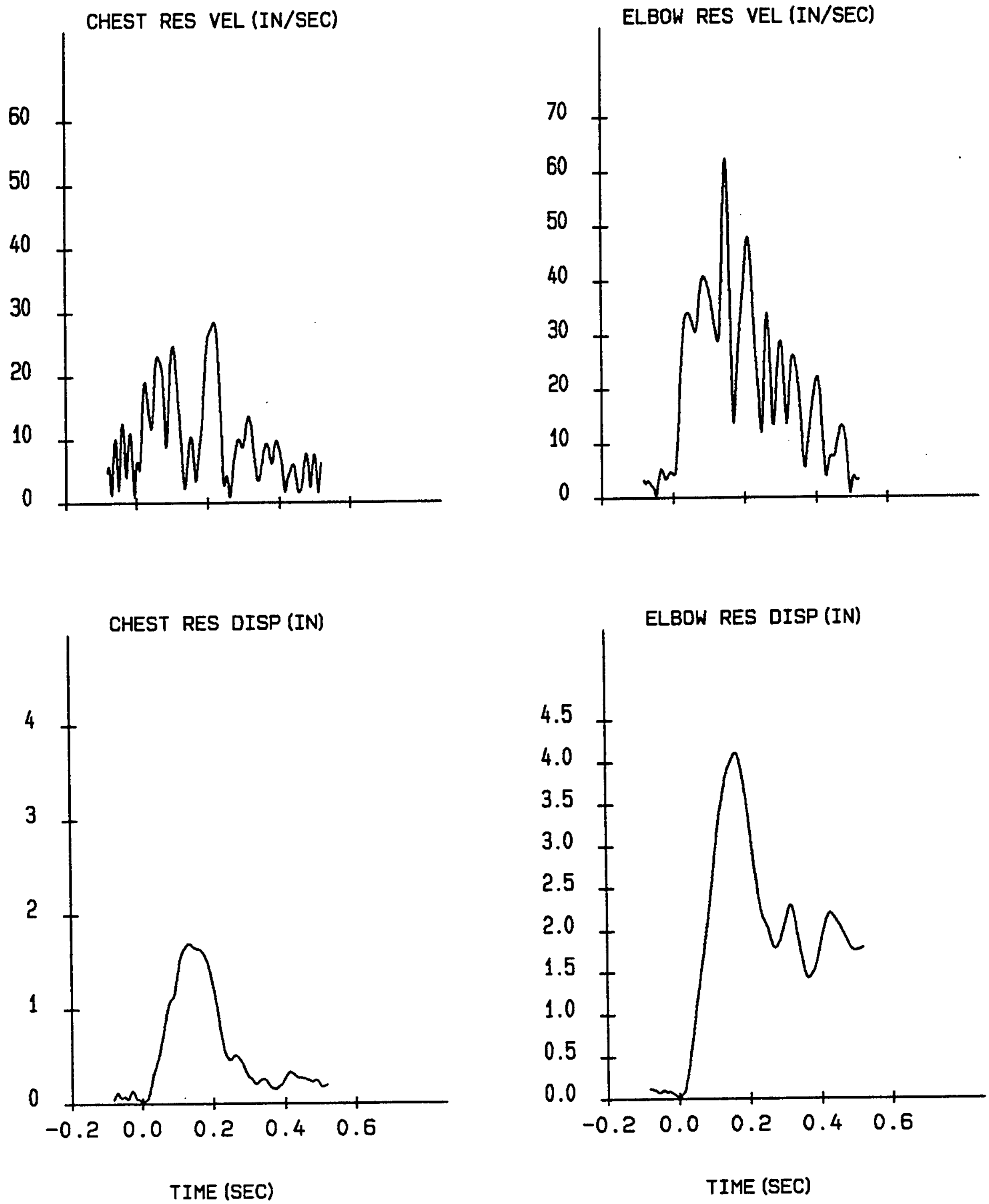
DRI STUDY -GX

TEST: 5631 DATE: 31 OCT 1995 SUBJ: C-13 CELL: C



DRI STUDY -GX

TEST: 5631 DATE: 31 OCT 1995 SUBJ: C-13 CELL: C



DRI STUDY -GX

TEST: 5631 DATE: 31 OCT 1995 SUBJ: C-13 CELL: C

RELIABILITY FACTORS (IN)					
TARGET DESCRIPTION	MAXIMUM	MINIMUM	AVERAGE	STANDARD DEVIATION	AT MAX DISPLACEMENT
1 HELMET (TOP)	0.1580	0.0271	0.0890	0.0252	0.1190
2 HELMET (BOTTOM)	0.3643	0.1259	0.2261	0.0562	0.3055
3 MOUTH	0.3416	0.0002	0.0903	0.0580	0.0210
4 SHOULDER	0.1152	0.0017	0.0414	0.0204	0.0050
5 CHEST	0.0767	0.0002	0.0285	0.0170	0.0637
6 ELBOW	0.0824	0.0000	0.0181	0.0154	0.0101

PREIMPACT POSITION (IN)			
TARGET DESCRIPTION	X	Y	Z
1 HELMET (TOP)	6.2713	5.1301	34.5643
2 HELMET (BOTTOM)	5.1421	5.4331	31.3231
3 MOUTH	11.2658	0.9612	30.3947
4 SHOULDER	11.9657	1.0424	20.2760
5 CHEST	7.4373	8.8644	24.5681
6 ELBOW	8.7956	10.4544	14.0056

TARGET	MAXIMUM	TIME(SEC)	MINIMUM	TIME(SEC)
HELMET (TOP)				
POSITION(IN)				
X AXIS	13.2623	0.1840	6.2637	0.0100
Y AXIS	6.1161	0.3080	4.9677	0.0680
Z AXIS	34.5643	0.0000	29.9523	0.2060
VELOCITY(IN/SEC)	88.7137	0.1260	0.4918	0.5100
ACCELERATION(G)	7.2015	0.3160	0.1436	0.4700
DISPLACEMENT(IN)				
X AXIS	6.9910	0.1840	-0.0075	0.0100
Y AXIS	0.9860	0.3080	-0.1625	0.0680
Z AXIS	0.0000	0.0000	-4.6120	0.2060
RESULTANT	8.2791	0.1920	0.0000	0.0000

DRI STUDY -GX

TEST: 5631 DATE: 31 OCT 1995 SUBJ: C-13 CELL: C

TARGET	MAXIMUM	TIME(SEC)	MINIMUM	TIME(SEC)
HELMET (BOTTOM)				
POSITION(IN)				
X AXIS	10.5457	0.1800	5.1101	0.0100
Y AXIS	6.3166	0.3280	5.2768	0.0680
Z AXIS	31.3480	0.0120	27.8597	0.2100
VELOCITY(IN/SEC)	74.0280	0.1140	2.1353	0.4760
ACCELERATION(G)	5.7851	0.2240	0.5075	0.4960
DISPLACEMENT(IN)				
X AXIS	5.4036	0.1800	-0.0320	0.0100
Y AXIS	0.8835	0.3280	-0.1563	0.0680
Z AXIS	0.0249	0.0120	-3.4635	0.2100
RESULTANT	6.3366	0.1840	0.0000	0.0000
MOUTH				
POSITION(IN)				
X AXIS	14.7752	0.1500	11.2658	0.0000
Y AXIS	1.9194	0.3460	0.8093	0.0700
Z AXIS	30.4530	0.0120	24.4842	0.2080
VELOCITY(IN/SEC)	77.7680	0.1280	1.1491	0.5180
ACCELERATION(G)	7.6346	0.2200	0.2554	0.5060
DISPLACEMENT(IN)				
X AXIS	3.5094	0.1500	0.0000	0.0000
Y AXIS	0.9582	0.3460	-0.1519	0.0700
Z AXIS	0.0583	0.0120	-5.9105	0.2080
RESULTANT	6.5481	0.2040	0.0000	0.0000
SHOULDER				
POSITION(IN)				
X AXIS	13.2010	0.1260	11.9274	0.5120
Y AXIS	1.2545	0.3420	0.7628	0.2060
Z AXIS	20.5133	0.0940	19.8917	0.2300
VELOCITY(IN/SEC)	28.2861	0.2000	0.5357	0.2760

DRI STUDY -GX

TEST: 5631 DATE: 31 OCT 1995 SUBJ: C-13 CELL: C

TARGET	MAXIMUM	TIME(SEC)	MINIMUM	TIME(SEC)
SHOULDER				
ACCELERATION(G)	3.6065	0.2260	0.0701	0.4940
DISPLACEMENT(IN)				
X AXIS	1.2353	0.1260	-0.0383	0.5120
Y AXIS	0.2122	0.3420	-0.2796	0.2060
Z AXIS	0.2373	0.0940	-0.3843	0.2300
RESULTANT	1.2483	0.1220	0.0000	0.0000
CHEST				
POSITION(IN)				
X AXIS	8.9760	0.1340	7.2439	0.3400
Y AXIS	8.9748	0.4880	8.1527	0.1660
Z AXIS	24.6259	0.0680	24.1416	0.1340
VELOCITY(IN/SEC)	28.4399	0.2200	0.9347	0.2620
ACCELERATION(G)	3.5968	0.2360	0.1201	0.3600
DISPLACEMENT(IN)				
X AXIS	1.5387	0.1340	-0.1934	0.3400
Y AXIS	0.1105	0.4880	-0.7116	0.1660
Z AXIS	0.0578	0.0680	-0.4265	0.1340
RESULTANT	1.6917	0.1320	0.0000	0.0000
ELBOW				
POSITION(IN)				
X AXIS	12.7603	0.1480	8.7956	0.0000
Y AXIS	10.8148	0.1120	9.1008	0.2460
Z AXIS	14.2975	0.3240	13.7230	0.2760
VELOCITY(IN/SEC)	62.3635	0.1480	0.7191	0.4960
ACCELERATION(G)	9.1481	0.1640	0.4153	0.4720
DISPLACEMENT(IN)				
X AXIS	3.9647	0.1480	0.0000	0.0000
Y AXIS	0.3605	0.1120	-1.3535	0.2460
Z AXIS	0.2919	0.3240	-0.2827	0.2760
RESULTANT	4.1124	0.1640	0.0000	0.0000

DRI STUDY -GX
TEST: 5631 DATE: 31 OCT 1995 SUBJ: C-13 CELL: C

Note: Invalid samples are interpolated.

Samples 1021 through 1080 of the MOUTH target are invalid.
Invalid sample range occurred from -0.0820 seconds to 0.0360 seconds.

Samples 1143 through 1152 of the MOUTH target are invalid.
Invalid sample range occurred from 0.1620 seconds to 0.1800 seconds.

Samples 1175 through 1179 of the MOUTH target are invalid.
Invalid sample range occurred from 0.2260 seconds to 0.2340 seconds.

Samples 1295 through 1321 of the MOUTH target are invalid.
Invalid sample range occurred from 0.4660 seconds to 0.5180 seconds.

Samples 1155 through 1163 of the ELBOW target are invalid.
Invalid sample range occurred from 0.1860 seconds to 0.2020 seconds.

Samples 1173 through 1189 of the ELBOW target are invalid.
Invalid sample range occurred from 0.2220 seconds to 0.2540 seconds.

Samples 1219 through 1229 of the ELBOW target are invalid.
Invalid sample range occurred from 0.3140 seconds to 0.3340 seconds.